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American Statistical Association

Organized November 27, 1839
Incorporated 1841

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Subscription rate, $6.00 per annum. Single numbers of volumes 23 to 32, $1.50 per copy postpaid, except Supplements $2.00 per copy postpaid. Prices for complete sets or volumes available on request.

Published Quarterly by the AMERICAN STATISTICAL ASSOCIATION

Publication Office: 450 Ahnaip Street, Menasha, Wis. Editorial Office: 722 Woodward Building, Washington, D. C. Acceptance for mailing at special rate of postage provided for in the Act of February 28, 1925, embodied in paragraph 4, section 538, P. L. & R., authorized March 25, 1936. Entered as second class matter at the post office at Menasha, Wisconsin.

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DECEMBER, 1937 · $1.50 PER COPY · $6.00 PER ANNUM · VOL. 32 · NO. 200

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COMPARABILITY VERSUS CHANGE

By Vergil D. Reed, *Assistant Director*
Bureau of the Census

Even the role of recording angel must surely have its drawbacks. At any rate, the Census Bureau, as recorder of the nation's social and economic life, finds itself tossed about on an ocean of statistics by the fury of two uncompromising and opposing forces—comparability and change.

There are those who hold that "change breeds more mischief from its novelty than advantage from its utility." To them comparability must be the paragon of statistical virtues.

Opposed are those who feel that "In a higher world it is otherwise; but here below to live is to change, and to be perfect is to have changed often." To them change is needful even though painful; and inconvenience is the price of change whether it be from worse to better or better to worse.

Probably no subject is more discussed when statisticians or users of statistics get together than comparability of statistical series from one period to another as contrasted with the pressure for change in classifications or the inescapable changes which time dictates in the nature of the facts for which grouping is desired.

What is comparability? The dictionary defines it as "that which may be compared; fit to be compared." Perfect comparability of statistical data for any series over a period of time would represent the final achievement of a mathematical concept. It is socially fortunate, even though statistically regrettable, that perfect comparability in the field of population and economic activity over an extended period is seldom attainable. Perfect comparability is possible only in a static universe. In sharp contrast, change is the most typical of all characteristics in our social and economic order. The idea of a perfect vacuum wherein data are protected from the invigorating influences of changing realities is abhorrent to the real scientist whose main objective is to measure trends and changes—causes and effects.

It is the task of the Bureau of the Census to record actual existing conditions, not to determine what those conditions should be. This

bureau has had a long, extensive, and intensive experience with the conflict between comparability and change. The decennial population censuses date from 1790. Manufacturing data have been collected since 1810. Censuses of Agriculture have been taken since 1840. The first census of distribution was taken for 1929. Current statistics have been gathered for many years. The two opposing forces are common to all of these fields, yet the resulting problems vary widely as to nature, urgency, and degree in each of them.

In the censuses and inquiries carried over a long period of years, the necessary changes made at each succeeding one are usually much less fundamental in extent and effect on comparability than in the case of the newer series. In this respect, our problem resembles that faced by the automotive industry. At first, design changes were radical, fundamental, and largely based on trial and error due to lack of a background of experience. Through the years these changes became less and less radical, more and more superficial, and were based upon sound experience and research.

In the case of those census series started more recently, such as the censuses of distribution and monthly data on industry and business, it is true that we had the results of general experience in census taking as a basis for their planning and execution. In spite of that fact, however, many new problems had to be faced. Pioneering was particularly necessary in classifications and proper grouping. The reactions of respondents differed from those found in other fields. The demands and needs of the respondent himself expressed through well organized groups had to be, and should be, met in so far as practicable. A different type of enumerator and a different type of field organization were necessary. Different office techniques had to be devised.

All the factors cited, and many others, had to be faced as realities and not as theories. They have necessitated radical and fundamental changes in the second and third of our distribution censuses which have played considerable havoc with comparability. This, in my opinion, is a normal healthy condition necessary in the early stages of any new series. The necessity for radical changes will decrease with succeeding censuses and, consequently, an increasing degree of comparability will be attained without unjustifiable and misleading "forcing" of the data.

Each census may be thought of as a photograph which depicts our industrial, economic, and social status at a given time. A succession of still pictures, if taken at sufficiently short intervals, constitutes a motion picture and shows dynamic actualities rather than an album of static photographs. Keeping this motion picture true to life is a major objective of Census officials.

The number of factors affecting comparability in data of a census type with national coverage in a wide variety of universes is surprisingly large. Some of these are subject to increasing control. Others can never be consistently and accurately controlled either from time to time or from place to place.

New social and economic conditions are constantly arising to dog the steps of those who, although they appreciate the need of as high a degree of comparability as possible, must record and classify these volatile actualities without bias and without "forcing" the facts into classifications that are outmoded or non-existent simply to attain an unreal and misleading comparability. Statistical comparability must be based on classifications *fit to compare.*

The rise of new industries and new products makes new classifications necessary and old ones useless. The automobile, airplane, radio, Diesel engine, plastics, air conditioning equipment, and rayon wrought many such changes. One type of distributor rises while another either disappears or becomes insignificant. Mattress walkers came and cordwainers went. Accounting practices vary from one period to another, from one place to another, and from one trade or industry to another. Such variations have an important bearing on the collection of business and industrial data and changes in them must be met.

Labor laws, social security laws, income tax laws, and the needs of new agencies, both private and governmental, force changes both as to the facts to be collected and the classifications into which they must be fitted. Large retail organizations expand their operations into new fields. New stores and entire chains are acquired. They acquire factories and enter the field of wholesaling. The same organization acquires grocery stores, meat markets, combination stores, and bakeries. Former chains become voluntary cooperative groups of "independent" stores. Chicken "factories" compete with the poultry farmer and are moving into cities—even to hotel roofs where the present scope of censuses of agriculture cannot include them. Part-time farming by the former city dweller has become a great factor. Trailers complicate our population census problems. The depression has caused many fundamental shifts and changes which will not even be known until discovered and measured in the 1940 census.

Field operations and technique must vary to meet specific conditions. In spite of desire on the part of Census officials, different dates within the calendar year may be designated from time to time for the taking of any given census. Better qualified enumerators are available in a depression period than in a period of prosperity. The period of training for supervisors and enumerators may vary from one census to

another. "Split-establishments" (integrated organizations operating in several fields) are hard to break down on a strictly comparable basis at each census.

Variations in office methods and personnel are bound to affect the comparability of census statistics in spite of written editing and coding instructions, manuals of procedure and class instruction. The trouble begins even with the determination of the exact scope of the census or inquiry. Shall this border-line item be included or excluded? Shall manufacturers producing less than $5,000 volume per year be enumerated? Shall subscription agencies for magazines be included with retailers? Should those having no fixed or recognized place of business be enumerated? Why not exclude any so-called wholesaler who does less than $1,000 annual volume? Where do small bakeries belong—retail or manufacturing?

Definitions must necessarily vary and in spite of every safeguard they will, at least in some cases, be wrongly interpreted or misunderstood. If these definitions are vague, leave room for misunderstanding, or are open to multiple interpretations, the coders and officials to whom border-line cases are referred will find difficulty in determining what items should be included in and what excluded from a given classification. This difficulty results in shifts of a given establishment or individual from one class to another in different censuses. Hence, the definitions must at the same time be as accurate as possible and must not vary to any considerable degree from one period to another. Differences in the amount of detail given on the schedule at each census may also tend to cause similar shifts. Both definitions and classifications adequate today may be entirely inadequate ten years from today.

From the foregoing statements it is evident that the possible factors affecting comparability include variations in: (1) The social and economic structure itself; (2) quality of reporting; (3) editing; (4) coding; (5) tabulating; (6) analyzing; (7) definition of terms and classes; (8) the census date; (9) scope of census; and (10) units of measurement. The presence of these and similar conditions make comparisons over long periods extremely difficult, and at times dangerously misleading unless interpretation includes a knowledge of these limitations and their effects.

Specific examples drawn from various census divisions will aid greatly in acquainting the reader with the exact nature and extent of the problem of reconciling comparability and change.

The Census of Business, one of the new censuses previously mentioned, has been taken only three times. It is frankly admitted that the major emphasis has been placed upon getting the most complete cover-

age possible at each census with the available funds, time, and personnel. Comparability between censuses has suffered somewhat because of this emphasis. It is believed that the 1935 Census is complete enough in scope and coverage to be used as a base for future censuses. It is thought that most of the necessary changes in classification can be made without destroying comparability and with the extent of such changes known and pointed out clearly in future reports. A complete card index of retail establishments providing for the entry and comparison of major items for five censuses will permit ready checking of identical concerns and assist greatly in preventing unwarranted shifts from one classification to another, except in the case of new concerns established since 1935.

There was little precedent to guide in the collecting and presenting of business data in 1929, except the 120 years of experience gained in the Census of Manufactures. This experience failed to solve the problems of classification, however. This problem in classification may be appreciated from the fact that there were 343 minor and 24 major classifications for wholesale trade in 1929, 166 minor and 25 major in 1933, and 142 minor and 29 major in 1935. The large number of classifications and the shifts therein from census to census indicate the extent of change considered necessary. The same condition existed in retail trade.

These changes in classifications indicate that the Census of Business is going through a period of growth and development. The changes resulted from experience gained in previous censuses, from suggestions of business groups and statisticians, or from the exigencies of time and funds. Whatever their cause, they were made after carefully weighing their implications.

In addition to these conscious changes in plans, classification shifts have arisen from a number of other sources. Establishments were classified primarily on the basis of the information contained in the report submitted for a particular year, with no account being taken of the classification of that establishment in preceding years. The expansion of the census in 1933 to cover service establishments made it possible to draw more definitely the line of demarcation between retail stores and service establishments than in 1929. The increase in scope of the 1935 Census to include many other phases of our economic life also made for changes and refinements in classification.

In 1933 businesses were classified as service establishments only if their receipts from service exceeded two-thirds of their total receipts. It was felt that unless the determining percentage for receipts from merchandise sales was set at a low level during the depression, there

was danger of confusing what were essentially retail stores with service establishments. Because of the conditions obtaining in 1933, merchandise sales dwindled to such an extent that revenue from service, ordinarily a subordinate function of the retail business, assumed unusual importance. In 1935 the retail-service border line was established at the 51 per cent mark.

Other shifts between classifications were also due to the fluctuations of the business cycle. In trying to determine, for example, whether a store was doing a wholesale or retail, service or retail, construction or retail, manufacturing or retail business, the line of separation was drawn on a 51 per cent basis for all three censuses; that is, if 51 per cent of an establishment's business was at retail, it would be classified in retail. Thus, establishments classified as wholesale in 1929 might have become retail stores in 1933 and 1935.

Shifts also occur within the retail census itself, as well as from retail to service or wholesale. This was particularly true of stores handling a combination of such things as furniture and hardware, groceries and feed, clothing and general merchandise, or coal and buidling materials. A change in the relative importance of one of the lines sold might be great enough even under "the 51 per cent rule" to change the classification in which the store belonged.

The 51 per cent test was not used in classifying drug stores because few so-called drug stores do most of their business in drugs. Many of them do not even have a pharmacist and prescription counter. If the proprietor or corporation returned the schedule as a drug store, it was so classified.

In the Census of Manufactures the "capital" inquiry appeared in the schedules from about 1849 to 1919 inclusive. This inquiry was crude, to say the least, yet it was retained under constant pressure from those who valued comparability.

At the Census of 1921, in order to reduce the cost of the work and facilitate the compilation of the statistics, those concerns showing value of products manufactured of less than $5,000 per year were excluded. This meant that the lower limit was raised from $500 to $5,000. What did this change mean in terms of comparability? The total number of establishments covered by the Census for 1921 was 250,266, of which 53,999 reported products at less than $5,000. These 53,999 establishments, although representing 21.6 per cent of the total number, contributed only six-tenths of 1 per cent of the total wage earners and three-tenths of 1 per cent of the total value of products.

Changes are constantly taking place within the industrial classifications of the Census of Manufactures. Comparability may be disturbed

in some of the sub-classifications, but the main industrial group of which they are a part as a rule is not disrupted.

One of the most recent examples of classification change occurred in the Textile Products Group. At the recommendation of textile manufacturers, prior to taking the 1935 Census, those dyeing and finishing departments operated by cotton mills at the same location as the mills were included in a new classification called "Dyeing and Finishing, Cotton, Rayon and Silk." In former censuses, these departments of the cotton mills were treated as integral parts of the mill and, therefore, were included in the classifications "Cotton Goods" and "Cotton Smallwares." As a result of these changes the individual industries are not strictly comparable with former classifications, but the comparability of the textile group as a whole is not affected. The textile trade, however, feels that the *"improvement" in classification far outweighs the loss due to the lack of comparability.*

In the Census of Population, occupational classifications are an excellent example for our attention. To keep these classifications realistic, it has been necessary to make many changes in them to conform to the rapid and extensive occupational changes which even the last few decades have brought about. Under such conditions the Census classification of occupations cannot assume the unchanging character of a map grid or fixed framework.

Most population reports are made by the housewife. The occupational designations or descriptions given are neither scientifically accurate nor technically exact. They are given in popular terms common to the community of the respondent. In converting the returns into statistics the classifications bear the unmistakable mark of this popular terminology which changes with the times. Even the occupational indexes used for coding purposes must be made up largely from terms reported at preceding censuses. The occupational terminology of the people cannot be standardized any more than language and industry can be standardized. Occupations disappear or their names or meaning change. Old terms become obsolete. New terms must be added.

In spite of all these difficulties, there is real need for greater comparability between occupational statistics both as to time and as to those collected and compiled by different agencies. Any improvement in terminology would be a real contribution.

Vital statistics must be predominantly current in nature rather than of the census type as that term is generally understood. On the other hand, such statistics assume an international importance not common to most other statistical compilations. These data are collected largely

through local medical officers, vital statisticians, and registrars. All these differences justify the citation of vital statistics as a field in which even international comparability is highly desirable but comparability by counties and states has not yet been attained due to the many difficulties faced.

It is commonly assumed that the problem of securing comparable mortality statistics will be solved if satisfactory readjustments can be made in the International List of Causes of Death. It is true that adjustments are essential in order to modernize the List to bring it into alignment with advances in medicine. However, other factors are involved in the production of statistical comparability of tabulations based upon the rubrics of the List. Among these factors are such items as: (1) The necessity of keeping comparability over time periods during which the List is being changed; (2) adjustment to the constant growth and change in terminology essential to changes in medical practice; (3) corrections for inaccuracies in the original notations on cause of death as written by the physician; and (4) the need for a consistent methodology in the selection of the primary cause of death to be tabulated when several causes are noted on the certificate.

In the collection of fatal traffic accident statistics, two distinctly different viewpoints give rise to discrepancies. From the standpoint of traffic control, the primary necessity is to arrive at an understanding of the causes of such accidents, while for statistical comparisons, the primary problem is to obtain comparability between the statistics gathered from different areas. To be sure, there is considerable overlap in these two viewpoints. A traffic department not only wishes to arrive at the cause of the traffic accident, but is interested in comparing the real gains or losses made in its particular city with those of others, and the statistician, whose primary interest is in comparability, is also concerned with cause of accident.

Looking forward to geographical comparability and coordination, as well as purely statistical comparability, the Committee on Accident Statistics, of the American Public Health Association, recently made the following suggestions:

> (1) That the Bureau of the Census canvass the States and ascertain their activities relative to collecting, tabulating, and publishing accident data.
>
> (2) That the Bureau of the Census study existing supplementary accident reporting forms with the object of preparing a standard form.
>
> (3) That a study of accidents by the Bureau of the Census, in addition to the collection and analysis of such supplementary schedules, be conducted as a series of sample inquiries over limited periods of time in cooperation with the several States; that such inquiries involve the use of field workers, State or Federal, and be conducted in a manner similar to epidemiological surveys.

(4) That the procedure on accident analysis by Registrars and the definition of accident terminology be surveyed under the direction of the Bureau of the Census and incorporated as a part of the Instruction Manual of the Director of Vital Statistics.

The agricultural statistics "size of farms" furnish an outstanding example of change versus comparability. Originally the farm size classes were based upon judgment and convenient numerical separation, without much consideration to the general land survey system in use in the United States, i.e., sections, quarter-sections, etc. As this land layout really results in the "size of farms" clustering around 20, 40, 60, 80, 120, 160, etc., the significance of the size of operations was very seriously affected by the use of the former size groups. To overcome this, a new group was devised upon the basis of the United States land system unit, but in such manner that the old figures could be tied in and compared. In the 1935 Census of Agriculture both new and old groups were shown.

The Farm Census furnishes another example involving population. Large numbers of farm operators, listed in the agricultural census as farmers, have other occupations ranging from laborers to bankers. Under the present method we have one series of figures for farmers from the agricultural census, but another from the population figures classifying those gainfully employed. Formerly this number was not sufficient to cause much difficulty, but owing to changing conditions and the need for more exact definition in the classifications necessitated by new laws, this discrepancy must be accounted for. To overcome the difficulty it is proposed in the new farm census schedule to carry a question on "other occupations" and arrange it so that this can be separated from the "farmer figures," thus harmonizing the two series. Further, to advance the separation and define the border-line material, a 200 page statistical study of part-time farming has just been prepared, as part-time farmers constitute a large portion of the "two occupations" group.

Of the many similar examples illustrating changing conditions which upset comparability, found in agricultural statistics, are types of farms, changes in price level affecting the lower range of farms under three acres with the valuation of products' limitation, the change of green manure crops to a cash crop basis illustrated by the soy bean, changes in dates affecting all livestock classes, changes in farming practice affecting crop acreage such as from inter-planted crops to solid acreage, succession crops, and land in orchards planted to cash crops.

The question is often asked of Census officials, "How do you decide

on the changes to be made?" With but few exceptions they are made after thorough and careful consideration by several qualified individuals in conference. Only those changes which are of small consequence are made on the decision of a single individual. We have no question as to the necessity of maintaining comparability and no changes affecting it are lightly made.

A Census Advisory Committee, made up of six outstanding members of the American Statistical Association, meets regularly with our staff and we are guided much, both as to policy and practice, by its counsel. Most of the various divisions of the Census Bureau have their own standing committees drawn from the leaders of the particular field covered. These committees serve without pay but the quality of their work and the amount of time contributed are most helpful and most generous. Through these committees we not only seek technical advice but better and closer contact with groups which represent the respondents and users of the data after compilation.

The Central Statistical Board is consulted with reference to all schedules and inquiries and it is a major function of that organization to promote comparability of statistical series as well as to coordinate the government agencies.

Conferences with representatives of interested groups, both private and governmental, precede all censuses and all current inquiries. For instance, in planning the Census of Business, 1935, over a hundred business leaders came to our Philadelphia headquarters for announced conferences. Many others were consulted individually as the need arose. These conferences contributed much toward proper schedules; toward securing the maximum of useful data with the minimum of inconvenience to respondents; and toward proper classification of the data to assure maximum usefulness.

As to the methods of minimizing changes and maximizing comparability, a number of suggestions are listed below, with the idea of stimulating further thought. They are by no means presumed even to approximate a final solution to the problem. A few of these suggested methods of approach are:

(1) Test the wording of schedules, the instructions to enumerators, and the office methods used in handling new classifications before adopting them, so that a bridge from the old to the new can be constructed.

(2) Have card records, schedules, and tabulations worked out in such a way that regrouping can be made according to both the old and the new classifications.

(3) Do not abandon the old series until the new one is devised, tested, and of sufficient value to take the place of the old series. This is particularly important in current series.

(4) Avoid, as far as possible, classifications based upon judgment alone, particularly judgment of the enumerators.

(5) Avoid use of supervisors who are inclined to use their own judgment instead of instructions.

(6) Avoid, as far as possible, classifications based upon a fixed point, for example a fixed percentage, when the nature of the series is such that it shifts back and forth.

(7) Arrange to have twilight zone material tabulated separately, so that it can be shifted from one classification to another if desired.

(8) Wherever possible, avoid changes in the date to which the statistics apply. If date changes are necessary, provide some means of measuring the significance of those changes.

(9) Check related series, as far as possible, and tie the work of one field in with that of another where necessary to give a complete picture.

(10) Assay the value of questionable series by leaving them out of the publication, and informing the public that they may be had by writing for them.

(11) Periodic enumerations, like photographs, are a cross section of time. A number of these enumerations placed together form a moving picture. In order to get the flow of the series to correspond with actual conditions, it may be necessary to apply the technique of the animated cartoonist or continuity man; that is, smooth the curve.

(12) Series which are expected to be used over a long period of time should be revised periodically. The International List of Causes of Death, for example, is revised every ten years.

In attempting to solve the problems of comparability versus change, or any other census problems, we invite your constructive criticism and welcome your assistance. Well conceived independent studies, aimed toward minimizing changes destructive to census comparability or maximizing comparability without stifling improvement, would be a welcome contribution to our national statistics. We feel that these problems are yours as well as ours.

THE WHOLE DUTY OF THE STATISTICAL FORECASTER

By Robert W. Burgess
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Professor Pearl's article in the December 1936 Journal regarding the work and personality of Karl Pearson calls attention once more to the important and fundamental contributions to statistical methodology made by that great scientist. The very excellence of this presentation, however, combined with the prominence in statistical literature of the mathematical methods originated and developed by Pearson, R. A. Fisher, and others, may throw somewhat out of focus the general picture of statistical analysis in all its phases as it is and should be used by economists, educators, business statisticians, and others. Unless supplemented by presentation of other points of view, such emphasis on mathematical methods of a particular type may even tend to divert effort from the channels which it is most advantageous to develop at the present stage of statistical growth in this country. Moreover, when these mathematical methods are carried over from the field of biology, where controlled experiment is usually practicable, into the field of social sciences, especially economics and business administration, there may not always be full appreciation of all the modifications of method and the supplementary methods which are necessary to secure helpful results.

In the following paragraphs, therefore, an attempt has been made to discuss in a broad way the functions of the less fully advertised phases of statistical work, with special reference to the point of view of statistical forecasting. It is urged that painstaking and intelligent handling of all these phases, even though some of it may be scorned as "low brow" by those who rejoice in elaborate machinery, is essential to reliable statistical conclusions. It is realized that some of this discussion may reflect unduly the particular experience and observations of the writer, even though the attempt has been made to test all statements by application to problems arising in a number of fields and under various conditions. Even though amendment and supplement may be necessary, however, it still seems worth while to present a point of view regarding the whole duty of the statistical forecaster.

The fundamental gospel of statistics is to push back the domain of ignorance, prejudice, rule-of-thumb, arbitrary or premature decisions, tradition, and dogmatism and to increase the domain in which de-

cisions are made and principles are formulated on the basis of analyzed quantitative facts. Ideally, we may hope to let in the full light of day to illuminate what has been dark, but practical limitations often compel progress by inches, and by substituting for some completely unknown element, something that is still only partly known. From the point of view of the business statistician, progress is being made as long as the final state is less dark than the first.

In order to make progress in this sense, it is necessary to do many things in addition to developing the principles of mathematical statistics and statistical probability. It is recognized that many of these things were, in fact, done and are still being done by statisticians distinguished for their mathematical contributions, but they have not always been emphasized in accounts of their achievements. In compact phraseology, some of the things that the statistician must do, in these other phases of his work, are: Grub—Grind—Graph—and Guess.

GRUB

The good statistician, or if he is lucky, his good assistants, must go beneath the surface of published statistics, of proposed classifications and even of proposed problems stated to him by specialists in other fields, and find whether everything really is as it seems. Investigation often shows that the same definition of terms has not been used consistently throughout and off-line cases must be adjusted before the results can be used with confidence. Again, terms may have been used in a specialized sense clear to the first user or compiler but not carrying the same meaning to the prospective user in other fields. For instance, for some basic commodities, the accepted series for quantities delivered to fabricators are labeled "consumption" series even though they fail to reflect quantities actually entering the fabricating process because of variation in stocks kept on hand.

Again, it may develop after a little discussion when a problem is put up to the statistician, that the real difficulty is not what it is stated to be. For instance, the statistician may be asked to explain the construction of the cost of living index number and to work out the changes in the different components in a certain period, when what is really needed is information which will help a wage-earner to adapt his living standards to his income. The business statistician needs a general familiarity with the work of his colleagues and a willingness to go into their problems far enough to find where statistical methods will really help.

A good example of grubbing is the study summarized by Mr. George

A. Eddy in the May 1937 issue of the *Review of Economic Statistics* under the title "Security Issues and Real Investment in 1929." By a reexamination of each security issue, Mr. Eddy shows that the generally accepted figure for new security issues in 1929 was in fact about four times what it should be. Many other examples of grubbing could be cited by government statisticians, whose work calls for much straightening out of actual or potential difficulties of this general type.

It may be noted that the results of grubbing are often negative in that they show that published material does not mean quite what the uninformed think it means and therefore is not conclusive when used to support certain broad conclusions. The justification for grubbing is that it is better to know about such limitations on the data than to act with unjustified confidence on the basis of a faulty interpretation.

It is not intended to imply that the grubbing statistician does or should ignore the flowers that should ultimately spring from the roots near which he is boring. On the contrary, there are so many possible ways of refining crude data that he must have an eye on results in order to concentrate on those refinements which promise to be significant.

GRIND

Even after the fundamental data have been examined at the roots by the grubbing process, and basic mathematical methods have been determined, sound statistical work requires a great deal of "turning the crank," that is to say, carrying through of indicated computations. In the field of construction of desirable tables to facilitate statistical computations, the work of the school of Karl Pearson has been outstanding. Another group really embraced within the statistical field which has not hesitated at elaborate computations is that made up of the actuaries and their allies. Here and there through the statistical field, to be sure, there have been formulas developed with the sole object of by-passing required computations, even at a significant loss in accuracy, such as Sheppard's corrections and certain approximate methods in correlation. On the whole, however, statisticians of all types have been willing to grind and have done so as far as resources permitted. Sometimes the people who hold the purse strings, however, have not seen the necessity for the associated expense and have professed themselves satisfied with the fairly reliable estimates which a trained statistician experienced in a particular field can produce. For sound statistical work, the luxury of the off-hand estimate can be afforded only when it springs from a background of analysis of similar problems.

GRAPH

By this word it is intended to cover the whole process of bringing statistical results to a head and interpreting their meaning. Graphing in this broad sense requires an appreciation of the point of view of the people who have to use the statistics, such as business executives, Government and educational administrators and the investor. Business executives, for instance, have to make decisions and accept responsibilities regarding problems concerning which they cannot possibly be masters of all the legal, political, statistical, technical psychological, and scientific questions involved. The duty of the statistician in a business organization or in the social organization is to bring out clearly the main conclusions of his statistical analysis, together with the limitations of the data and his view of the application of the conclusions to the major problem. To the extent that this is done efficiently, final decision of the responsible executive is facilitated. It is often true that graphical representation is of great assistance in bringing out main conclusions, in a form that can be easily remembered and coordinated with non-statistical factors. Such graphing or other explaining will often seem like a waste of time and effort when viewed in detail, but since it is a key function in making statistics a guide to action, it is really of major importance.

GUESS

Even after the statistical forecaster has faithfully grubbed, ground and graphed to the best of his ability, resources and available time and energy, there will remain many aspects of almost any problem which have not been completely and scientifically analyzed. In particular, if the problem involves future contingencies, there will always be elements that are in the lap of the gods. It is therefore an essential phase of the work of the statistical forecaster to "guess," that is to say, to supplement the facts of record and his analysis thereof by the best possible conjectures regarding other factors. It is not intended to suggest that the statistician should ever make a completely arbitrary selection among the possible answers to doubtful questions, but that it may be necessary and desirable to select on the basis of very inadequate information rather than to omit a factor altogether.

In view of the strong hold, especially on the academic mind, of the desire for perfect proofs, it may be well to elaborate a little on this thesis. It has been said that you can solve a problem by computation or you can guess the solution, but you should never mix the two processes. The present thesis is that in almost any important problem in-

volving forecasting, the actual process of thought used in helpful solutions necessarily includes both computing and guessing (or if you prefer, judgment and consideration of intangible factors). To bring out the point, let us briefly consider the processes of thought involved in two important problems:

1. Purchase of Stocks

The statistician who is selecting a stock for investment or speculative purposes utilizes, of course, all the published information regarding the earnings, assets, sales, and other factual records regarding the company concerned. He finds, however, much less in print about the public attitude toward the commodity or service which the company provides and about developments which may lead to a change in that attitude. And he will find almost nothing at all, except perhaps unsubstantiated generalities, about the efficiency and integrity of the management, the morale of the organization and the methods it is employing to assure a continuous stream of capable leaders in future years. It may well be, therefore, that an accidentally dropped remark revealing something about the character of the management may be a more important element in his final judgment than the entire registration statement.

2. Forecasting General Business Conditions

Any reasonable attempt to forecast business conditions a year or two ahead must pay some attention to probable political changes. If the consideration of this factor is based merely on published information and personal contacts appraised with an unprejudiced eye, the forecast will tend to be more accurate than if this factor were ignored. The forecast will be still sounder scientifically, of course, if a survey of public attitude is made and analyzed by the use of sound sampling procedures. The point is that the political factor should be considered by the methods which are most appropriate for the consideration of that factor, even though they are not as accurate or as satisfactory as the methods which can be used in connection with the analysis of the recent trends of production, prices, purchasing power, etc.

In general, when the statistician surveys any problem, he is likely to find that some aspects can be covered very adequately from the statistical point of view, others can be taken care of sketchily, while others can hardly be touched. From the point of view of the practical statistical forecaster, any further effort which can be made should be

concentrated on the points where additional light would have the greatest effect on one's balanced judgment as to the proper action to be taken.

The general point of view as to the importance of guessing, judgment or weighing of intangible factors, may be enforced by consideration of the elements of any statistical problem which actually require this procedure.

1. Determination of Units

In the first place, the very determination of the units of measurement and the application of these units under varying circumstances often require considerable exercise of judgment. For example, when is a person to be counted as unemployed; how shall causes of death be classified; when shall a baseball player be credited with a hit, or when shall the opposing fielder be debited with an error?

2. Interpretation of Existing Series

Many standard derived series do not have exactly the meaning which the uninitiated think and it becomes a matter of statistical judgment whether the series can properly be used in the given problem. For instance, the Bureau of Labor Statistics Index of Wholesale Commodity Prices does not, in fact, cover highly fabricated commodities as satisfactorily as others, although it does attempt to include them to some extent and thereby differs from certain other wholesale commodity price indexes. It is obvious that this index does not constitute a guide as to the proper trend of prices of a highly fabricated piece of machinery nor is it comparable with the price trend for a basic agricultural product or mineral. The applicability in any particular problem must be decided on the basis of all the circumstances, some of which may not be completely measured. As another example, the Index of Manufacturing Production prepared by the Federal Reserve Board is necessarily built up by the use of those series expressed in physical units which are available over a considerable number of years. To the extent that manufacturing production is not fully represented by such series, the index is unsatisfactory for comparisons, especially those involving a long term.

3. Likelihood of Change

The psychological attitude or physical conditions back of most statistical ratios or other measures are changing from year to year or even from day to day. For instance, consider the background of

such typical statistical measures as average age at retirement, birth rate, production per acre, correlation of price and supply, annual demand for shoes per capita, and the like. In terms of the theory of probability, these statistical measures are based on drawings from an urn which contains white and black balls in proportions which vary irregularly from time to time. It is the function of a statistician to apply these measures in future forecasts only after the broadest and most accurate practicable consideration of all the indications that may be available of how the composition of the urn has been changed.

4. *Inadequacies of Record*

Because of the pocket-book interest, political attitudes or personal reticence of those concerned, the printed record often cannot cover all the factors of a given problem. Other factors must be inferred from hints, inside information, or even hunches.

The argument in favor of considering intangibles before reaching a final recommendation based on statistical analysis does not justify relaxing one's attitude of caution and freedom from bias. The fact that an executive says that in the future, company policy will be so and so, should be considered in connection with the past record to see how far similar declarations of general policy have been reflected in actual results. The personal preference that we have for an upturn in the business cycle is an intangible that has no place in statistical forecasting, but is only too likely to creep in indirectly in the way facts are selected or statistics rounded off. It would, admittedly, avoid grave dangers of prejudice and bias to "consider no evidence not supported by analyzed facts," but the complete omission of all factors which cannot be so supported would often widen the difference between forecast and outcome.

In conclusion, the aim of this note has been to call attention to the important functions of grubbing, grinding, graphing and guessing in statistical work, especially statistical forecasting. It is recognized that there are other important things for the statistician to do—know the fundamental mathematical technique, acquire an encyclopedic knowledge of all published material in statistical method and in the fields related to his specialties, and cultivate contacts with colleagues and other statisticians. These other things have already been emphasized by other writers and by general acceptance in academic circles. This note will be well justified it if redresses the balance a little in favor of statistical functions which are often ranked lower in hierarchical standing.

CONSTRUCTION COSTS AND REAL PROPERTY VALUES*

By Frank R. Garfield, *Board of Governors of the Federal Reserve System, and* William M. Hoad, *Central Statistical Board*

Many people in private positions and in government agencies need accurate information about the level and the course of construction costs and real property values in order to work out satisfactory long-time policies and to plan day-to-day operations. Those most directly concerned are construction contractors, architects, buyers and sellers of real estate, lending institutions, public utility commissions, government building officials, and planning and taxing agencies. Economists and business analysts generally recognize the great importance of fluctuations in construction activity in general business movements and have a special interest in construction costs as they affect activity.

Few people, however, have recognized fully the need for careful analysis in this field and most of those who have tried to work out answers to pressing problems have not had sufficient information at hand. Frequently they have used available cost indexes to serve purposes for which they were not suited. Sometimes they have constructed new indexes by methods which the Supreme Court characterized as "dubious and obscure."[1] In general, analysts in this field, as in many others, have sought quick answers to problems without scrutinizing the data carefully and have hardly considered the possibility of working out a long-time program for the provision of more adequate information. Changes in property values—costs from the standpoint of the purchaser— have been recognized as extremely difficult to measure and, except for annual reports on farm land values, few current data have been generally available. The course of rents is often used to indicate the course of property values but at times this leads to incorrect conclusions, partly on account of inadequacies in rent figures and partly on account of differences in the amount and timing of movements in rents and in values.[2]

Recently some progress has been made both in providing additional cost data and in improving the analyses of existing information. Attention has been called to some of the inadequacies of existing series and

* Revision of a paper presented at the Ninety-eighth Annual Meeting of the American Statistical Association, Chicago, December 28, 1936.

[1] West et al v. Chesapeake and Potomac Telephone Co. of Baltimore City, 295 U. S. 662

[2] See Homer Hoyt, *One Hundred Years of Land Values in Chicago*, for analysis of differences in timing.

to some of the advantages of compiling separate series to take account of differences by type of construction and by locality.[3] Also, some of the indexes now being published are based on bid prices or on actual costs per unit of completed work and are more satisfactory for the types of construction covered than the labor-materials cost indexes.[4]

This paper has been prepared primarily to emphasize the significance of certain distinctions which analysts in this whole field often overlook and to suggest possible methods of improving current information, particularly with respect to the cost of houses.

ORIGINAL COST OF PROPERTY AND ANNUAL COST OF OWNERSHIP

Again and again in discussions of changes in costs and rents and their effect on the volume of residential building, no distinction is made between original cost, a capital sum, and the annual cost of ownership, an amount per year. Actually, however, prospective buyers are interested in the annual costs incidental to ownership and these depend not only on original cost but also on other factors, such as interest rates and tax rates, which fluctuate in their own fashion.

In calculating the annual cost of ownership buyers do not use any uniform method and often fail to take adequate account of such items as repairs and special assessments, but they do know the amount of the down payment and of the current payments on any mortgages and consider some other items, such as taxes and insurance. Annual cost is sometimes thought of on an outlay basis, sometimes on an accrual basis. Outlays, including repayment of loans, are important because they represent a burden on the buyer's income, and failure to meet obligations may mean loss of the property. Estimates of costs on an accrual basis, including anticipated depreciation or appreciation on the property, permit the buyer to compare the cost of renting and owning more closely and to figure the return on his investment.

Rates of interest, taxes, and the like enter into annual costs and do not fluctuate closely from year to year with original cost. During the winter of 1936–1937, for example, interest rates on mortgages were declining, while the cost of labor and materials, the price of land, and the size of the contractor's margin, which together make up most of the original cost of new property to the purchaser, were rising.

[3] See especially Corrington Gill, "Construction Statistics," this JOURNAL, March 1933; James S. Taylor, "Construction Cost Statistics," Proceedings Supplement, this JOURNAL, March 1934; Lowell J. Chawner, "Construction Cost Indexes as Influenced by Technological Change and Other Factors," this JOURNAL, September 1935.

[4] See, for example, *Public Roads*, Vol. 14, pp. 81–92, and reports by the Bureau of Valuation of the Interstate Commerce Commission.

This major distinction between original and annual costs has been recognized in some analyses of building conditions, but it is stressed here because it is so often disregarded. Perhaps some day additional information may be available indicating more clearly the course of both original and annual costs to the purchaser, and making possible more meaningful discussion about the course of costs, rents, values, and the volume of residential building.

ORIGINAL COST

Considering original cost only, there are a large number of distinctions that make a real difference in analyzing events. Certain of these distinctions are discussed in some detail below, with some data to suggest how much difference they make. Various other distinctions have been kept in mind but their importance is not discussed here. Nothing is said, for example, about the relative cost of public and private construction; about costs of prefabricated houses; about cost differences between large scale developments, involving the erection of many houses of similar design by a single operative builder and the construction of custom-made houses to individual design; or about variations in the cost of construction as between different contractors doing the same type of work in the same locality.

The distinctions discussed below relate to newly-built and old structures; the type, size, and material of structures; the locality; and the cost of labor and materials as compared with the total costs to the contractor and with the cost of the whole property, including land and the contractor's margin, to the purchaser. The analysis of the cost to the purchaser is based largely on a special tabulation of data from the Financial Survey of Urban Housing so far as it relates to one-family houses.[5]

Newly-Built Structures and Old Structures

Any adequate analysis of the cost of houses to purchasers must recognize the direct competition between new and old houses. At times such as the present, for example, when lending agencies hold considerable real estate which they wish to sell, prospective home-owners may find the price of houses already built lower than the cost of a comparable new house by an amount larger than in some other periods when fewer old properties are on the market and costs of building new are relatively lower. Prices of old houses may also vary considerably

[5] This special tabulation was made through the assistance of the Federal Housing Administration and the cooperation of the Department of Commerce, which made available material collected in the Financial Survey of Urban Housing.

from what might be expected on the basis of rents. In general the differences in movements of prices for old and newly-built houses appear to warrant careful analysis, but this field has not been explored in this study.

Type, Size, and Material of Structures

The importance of separate indexes for various types of construction, such as road building, factory construction, and residential building, has been demonstrated in such analyses as those by Taylor and Chawner and in such compilations as those made by the Bureau of Public Roads and the Interstate Commerce Commission. Series by type of structure are desirable not only because various items of cost differ in importance but also because technical changes proceed much more rapidly in some cases than in others. Road building in recent years has been an example of rapidly changing techniques. When techniques change rapidly an average bid cost or an average cost per completed unit of work is a more accurate measure than an index based on some of the principal labor and material items. In this study, concerned primarily with the one-family house, the general approach has been to analyze the course of average prices paid for the house and lot rather than to follow through the course of various costs that make up the total. This procedure was used partly because data were not available on many important items relating not only to matters of construction technique but also to such items as contractors' margins and land.

The data used are based on reports by owner-occupants at the beginning of 1934 as to the original cost of their properties, including land, in the year when the houses were built. Most of the reports were for wood houses, principally of 5 and 6 rooms. The first chart shows how many owners in Cleveland reported various original costs in 1924 for 5- and 6-room wood houses and for all types of one-family houses, except that 13 houses costing $28,000 have been omitted. The chart suggests at once that, while averages for all types of one-family houses might be useful for some purposes, a time series based on such averages might not be a satisfactory measure of price changes, because it might be influenced by changes in the proportion of high-priced and low-priced structures.

The two lower lines on the chart indicate that, by using reports on wood structures of a similar size, of which many are built on roughly similar plans and in similar local areas, a more homogeneous sample can be obtained. They also suggest that a time series based on averages

CHART I

COST OF NEW HOUSE AND LOT TO PURCHASER, CLEVELAND, 1924

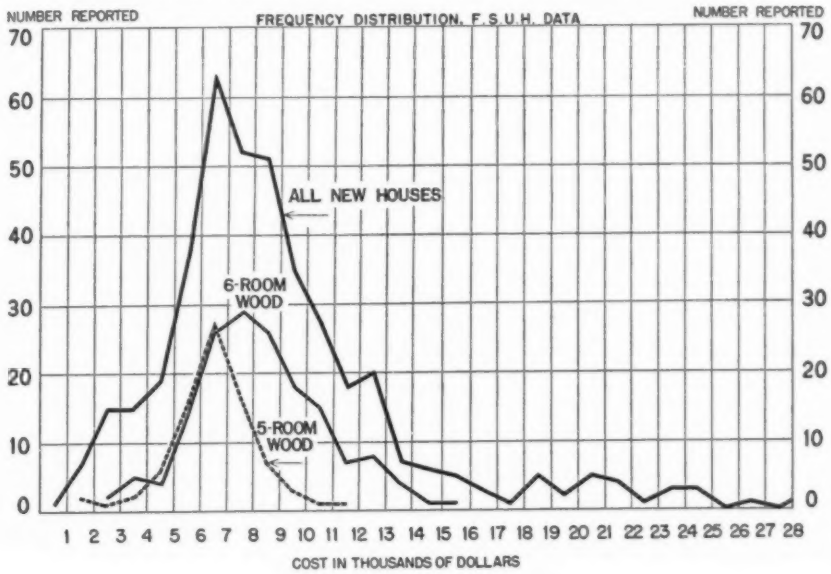
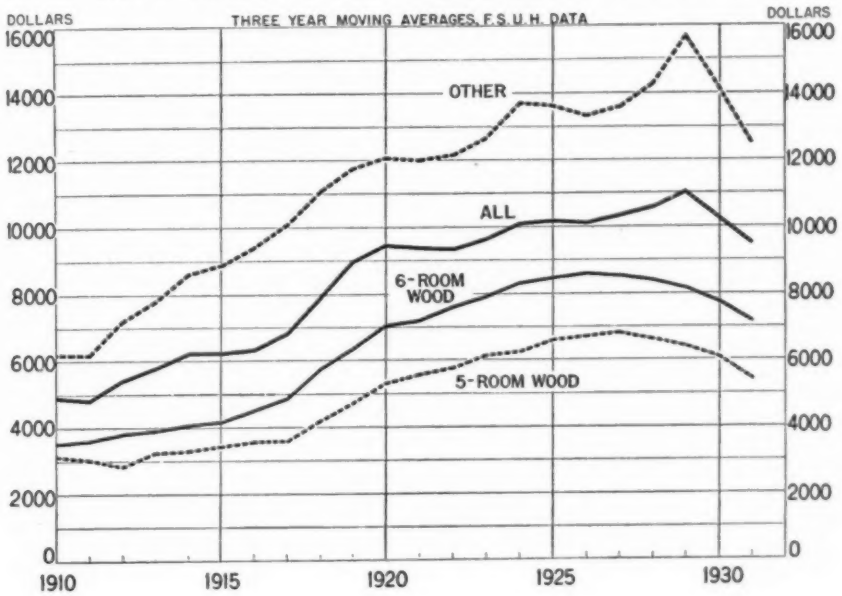


CHART II

COST OF NEW HOUSE AND LOT TO PURCHASER IN CLEVELAND



of these data might be more accurate for measuring price movements than a series based on all types. Of the 5-room wood houses, about one third cost between $5,000 and $6,000 and two thirds cost between $4,000 and $8,000 with the remainder evenly distributed below and above those classes.

The second chart shows such time series, on a three-year moving average basis, over a long period. The curves for 5-room and 6-room wood houses are believed to be much more satisfactory measures of price changes than the curve for all types of one-family structures. Comparisons, particularly over a long period, however, cannot be regarded as precise in view of possible differences in the accuracy of reporting and in view of changes in such items as the quality of construction and the size of rooms.

The way in which a change in the type of house built may affect average costs is indicated also in the following table showing building permit valuations for brick and frame 6-room houses built in Cleveland in the years 1929 to 1933.

PERMIT VALUATIONS

Averages for 6-room houses in Cleveland

	Brick and frame	Frame	Brick
1929	$5,410	$5,238	$6,930
1930	4,862	4,702	6,426
1931	4,487	4,200	5,314
1932	4,427	3,712	4,944
1933	4,438	3,665	4,761

Source: Bureau of Labor Statistics.

The decline shown for brick and frame structures from 1929 to 1933 was 18 per cent, while for frame structures alone it was 30 per cent and for brick structures alone 31 per cent. The difference reflected an increase during this period in the proportion of brick structures, which were considerably higher-priced than frame structures.

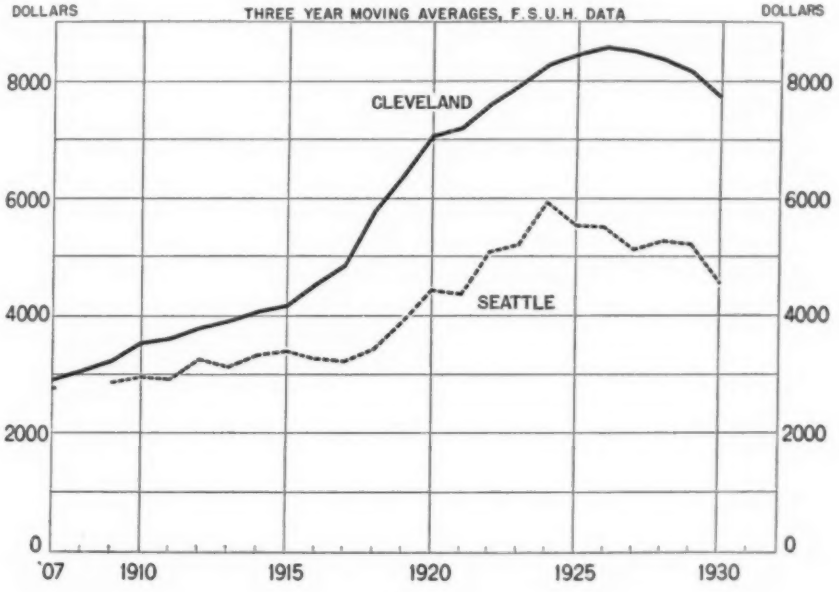
Locality

In different localities the average costs of houses show wide differences in level, reflecting such factors as differences in the type of construction, in wage rates, in prices of materials, which may be near at hand or distant, and in the price of land. There are also some differences in the amount and timing of changes, depending on many developments, including the rates of growth of communities, the timing

of building booms, and shifts in sources of materials. The accompanying chart for 6-room wood houses shows the extent of these differences in cost as reported for Cleveland and Seattle; and charts based on 5-room wood houses and 4-room wood houses show similar results. Differences may occur between sections of a single city or metropolitan area as well as between cities of different location and size.

CHART III

COST OF NEW 6-ROOM WOOD HOUSE AND LOT TO PURCHASER, CLEVELAND AND SEATTLE



The current cost indexes published by the Home Loan Bank Board for a standard 6-room structure, not including land, show considerable differences in cost movements in particular cities during 1936 and 1937. They also indicate substantial differences in level as between different communities. The choice of one standard type of structure for the whole country, however, has the limitation that in some communities quotations are on the cost of a structure which is not typical of the houses actually constructed. Also, in this type of index, which has a constant percentage allowance for contractor's margin, no allowance is made for changes in that margin with changes in market conditions.

Costs to Contractor Versus Costs to Home-owner

One common procedure in analyzing the demand for new residential building is to plot an index of labor and material costs against an index of rents charged and to compare them directly. This procedure has the disadvantage of ignoring the distinction between annual costs and original costs, and that between rents and values. It also fails to take account of the differences between costs to contractors and costs to buyers and between labor and materials costs to the contractor and his total costs.[6] The difference between total costs to the contractor and prices paid by the buyer reflect various items, including the contractor's margin and land prices, which at times vary differently from costs incurred by contractors.

Rather meager annual data for 25 cities, compiled in the special tabulation of data from the Financial Survey of Urban Housing, showed that fluctuations in prices paid by buyers differed from those shown by the labor-materials cost indexes but did not yield conclusive results concerning the amount of the differences. The samples were small, and at times, such as 1920, a bias appeared, owing to the fact that many home-owners who paid the highest prices lost their properties and were not in the sample of home-owners reporting in 1934 as having bought and built their present homes in 1920. Prices paid by purchasers did not fluctuate closely with the prices of labor and materials in some years, but the evidence studied was really only sufficient to suggest the desirability of further studies and of collection and analysis of additional data in the future, both for labor, materials, and other costs to the contractor and for prices paid by buyers.

IMPROVEMENT OF COST STATISTICS

The need for improvement in cost statistics is pressing, as events in 1937 have indicated. The discussion in this paper has focused on original costs, particularly of newly-built houses, furnishing some clues for increasing our knowledge in this field. It is to be hoped that the problem of obtaining adequate information on original costs of both newly-built and old structures will be explored further and that interested agencies will also press forward investigations concerning interest rates and other rates which, together with original costs, determine annual costs of ownership.

Two general methods can be used to trace the course of original costs of newly-built structures. One is to estimate changes in the total

[6] For discussion of items of cost to contractor, see Corrington Gill, cited above.

from changes in various cost items; the other is to measure changes in the total directly.

The first method has the advantage of indicating changes in the relationships between the parts, as well as fluctuations in the total, thereby providing a basis for planning action with respect to specific costs. Are the available cost indexes, which are computed in this manner, satisfactory for these purposes? They have been based generally on the cost of labor and materials only, showing nothing concerning changes in other costs to the contractor, the price of land, or the size of the contractor's margin, all important items in the total original cost to the purchaser. Labor and materials costs have generally been measured by nominal wage rates and quoted materials prices rather than by actual rates and prices and adequate account has not been taken of changes in the efficiency of labor and in techniques.[7] The figures of the Federal Home Loan Bank Board, available since the beginning of 1936, represent a definite improvement over national all-purpose indexes in that they are based on reports from contractors as to actual prices and wage rates paid, in that the weighting of the various items has been designed to fit a particular structure, and in that they are local series; but changes shown by these data reflect only changes in wage rates and material prices. Without considering in detail the various statistical deficiencies of available indexes with regard to weighting and other matters, it appears on the basis of items covered and the actual behavior of the various series that such indexes are not adequate for analyzing cost movements and working out a balanced program of action dealing with all items of cost. Careful studies should be made, therefore, to develop more satisfactory series of this general nature and in the meantime interpretations of current developments should be based on consideration of more elements in the picture than those included in the available indexes of building costs.

The second method, that of obtaining reports concerning the total cost of property directly, might provide a means of gauging developments more accurately than available cost indexes because it would include all items that make up the original cost of the property, new or old, to the purchaser. The statistical problems involved are considerable, but the analysis here has indicated that this approach is a useful one. Changes in total costs of new houses can be measured by the use of averages based on relatively small samples, provided a

[7] For differences between union and nonunion wage rates, see "Wage Rates and Hours of Labor in the Building Trades," *Monthly Labor Review*, August, 1937, Bureau of Labor Statistics, United States Department of Labor. For changes in average hourly earnings, see current monthly reports of the Bureau of Labor Statistics.

fairly homogeneous unit, such as the 5-room wood house or the 6-room wood house, is used. Changes in such costs can be checked by comparison with series based on houses of different size. Costs in one city can be compared with those in neighboring cities, taking due account of differences in the size of city and other factors affecting costs. This method of analysis permits, within limits, the selection in any one locality of the types of structure which are most typical of that locality; cities where apartment construction predominates, however, would present a special problem. In small places and in periods of little building, the problem of obtaining sufficient data to develop a current series at short intervals would be serious. Just how large the sample would need to be in any particular locality could be determined only by further study and would depend in part on the character of the community, the nature of the basic data, and the intervals covered. An annual series for Cleveland, based on owner-occupant reports in 1934, covering 150 to 200 new 6-room wood houses each year during most of the 1920's, was not subject to erratic fluctuations and indicated changes corresponding quite closely with those shown by series for houses of other sizes.

With series based on reports of total cost, as with those based on reports on costs of the constituent parts, the problem of obtaining accurate basic data requires careful study. The historical data used in this analysis were collected from home-owners in a sample study at a single date and were subject to various limitations which would not apply to data collected currently. Nevertheless data of this sort provide an approximate historical record useful as a background in interpreting current developments. Local real property inventories could include questions designed to obtain such historical information for all existing properties without unduly increasing the expense. The reports, however, would need to be supplemented by current information.

Data collected by the Federal Housing Administration in the course of insuring mortgages on both old and new structures constitute another important source of information on original cost to the purchaser. The records show the year built, the year bought, the price paid, and many details concerning such items as type, material, and size. They also show some separate estimates of the value of land which might provide one useful breakdown of the total. These records might provide considerable historical data and furnish a basis for more detailed analysis of costs than was possible in this study. Moreover, they might prove highly useful in providing prompt reports on

current changes in cost to the purchaser. The sample is restricted to properties insured by the Federal Housing Administration, which would be a more important limitation in some communities than in others.

One method of obtaining current information concerning original costs to the purchaser would be to use building permits issued and deeds recorded to obtain a record of new houses being built and old houses being transferred and then, after selecting the types of structure to be covered, to find out by inquiry the actual cost of the property to the buyer.

Two other sources of information may be useful in studying changes in the cost of new structures, but not of land, or of old structures. They are the prices specified in contracts and the valuations placed on structures in obtaining building permits. The F. W. Dodge figures on floor space and value of contracts might be examined in detailed fashion to see whether average cost per square foot by type, material, and size of structure, and by locality, would prove useful. Permit valuations might be analyzed closely to see how far changes in permit valuations reflect changes in costs and to develop series to measure changes in costs. Heretofore interpretations of contract and permit data on cost have been based largely on averages for a wide variety of structures. However useful such averages may be for some purposes, they are not satisfactory for measuring changes in cost because they are influenced by shifts in the proportion of buildings of various types, sizes, and materials. Recently the Bureau of Labor Statistics has made a special study of permit figures for 811 leading cities giving considerable detailed information including annual averages from 1929 to 1935 of valuation per dwelling unit and per room both by material and type of construction. For some of the cities cost per square foot or per cubic foot is also being computed.

Whatever data prove most useful, it appears that the first job is to obtain series satisfactory for particular localities. Such cost series could be used in interpreting local developments and also in obtaining some idea of cost changes by areas, by size of city, and for the country as a whole.

Pending the development of adequate cost statistics for residential building and also for other types of construction, people interested in current developments must rely on insufficient data, making such estimates as they can of both original and annual costs. And important policies will be based on those estimates!

THE PREPARATION OF CORRELATION TABLES ON A TABULATOR EQUIPPED WITH DIGIT SELECTION

By Paul S. Dwyer and Alan D. Meacham
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THE PRINTING OF THE TABLE. It is possible to use a tabulator equipped with digit selection for the purpose of printing the correlation table if one of the variables, say x, is a one place number or if the distribution for x has been coded into ten equally spaced class intervals. It is possible to obtain, at the same time, the sums of the frequencies by rows and, with an additional run through the tabulator by columns.

The following illustration was obtained by running 123 cards through the printing tabulator. The cards were sorted on the column for variable y and arranged in descending order. The machine was wired to distribute the frequencies for $x=0$, $x=1$, $x=2$, $x=3$, etc., into the columns labelled 0, 1, 2, 3, etc. The total frequency was recorded in the column labelled "Tot."

The method of wiring is described in the Appendix.

TABLE I

CORRELATION TABLE ON PRINTING TABULAR MACHINE SHEET*

y	x										*Tot.*	$C(x_y)$	$C(y_y)$
	0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*			
9				1	1	1	1				4	18	36
8												18	36
7				1			1				2	27	50
6	1	1	2	1							5	35	80
5	2	2	1	3	3	1	2	2	2	3	21	134	185
4	3	2	1	2	2	2	2	1	1	1	17	198	253
3		1	3	2	2	1	2	2	1		14	258	295
2	1		2	1	2	2	2	2	1	1	14	326	323
1	3	2	1	1		1	2	3	3	2	18	413	341
0	1	3	5	4	1	2	3	3	3	3	28	542	341
Tot.	11	11	15	16	11	10	15	13	11	10	123	542	341

* The items in italics and the rules are added to the machine sheet by hand.

The last two columns of Table I are explained later. The first row, containing columnar headings, was inserted after the table was run. The last row was obtained by running the cards through the machine with the minor control switch turned off.

A second illustration involves a variable y which has more than one digit. It is necessary to sort the cards for each digit of y so that the cards are arranged in descending order as indicated in Table II. The wiring, and the machine work are as before.

TABLE II

CORRELATION TABLE INVOLVING ONE TWO-DIGIT VARIABLE

y	x					*Tot.*	$C(x_y)$	$C(y_y)$
	0	*1*	*2*	*3*	*4*			
19	3	4	8	4	3	22	44	418
18	6	5	6	8	2	27	93	904
17	4	12	13	8	6	43	179	1635
16	5	3	8	10	10	36	268	2211
15	7	7	16	18	9	57	397	3066
14	7	15	28	14	10	74	550	4102
13	18	16	17	23	11	85	713	5207
12	15	22	30	25	15	107	930	6491
11	19	21	36	17	23	116	1166	7767
10	28	40	42	41	20	171	1493	9477
09	27	40	54	41	30	192	1884	11205
08	28	39	54	49	31	201	2302	12813
07	30	34	47	53	29	193	2705	14164
06	28	45	48	37	31	189	3081	15298
05	29	27	40	25	21	142	3347	16008
04	21	22	28	15	16	102	3534	16416
03	7	6	7	7	3	30	3587	16506
02	2	5	6	2	2	17	3618	16540
01		4		2	5	11	3648	16551
00	11	1		1	1	14	3656	16551
Tot.	295	368	488	400	278	1829	3656	16551

The first seven columns of Table II present the correlation table, with summaries by rows and columns, registered by 1,829 cards which had been punched with the two digit number, y, and the single digit number, x. In this case the value of x was at no time greater than 4 so it was only necessary to record $x=0$, $x=1$, $x=2$, $x=3$, $x=4$ and totals.

THE COMPUTATION OF MEANS, STANDARD DEVIATIONS, CORRELATIONS, AND SKEWNESSES

The last two columns of Table I and Table II give additional information which accelerates the computation of means, standard deviations, and correlation coefficients. These columns may be obtained simultaneously with the correlation table if a few wires are added and if the machine has sufficient capacity.

In Table I it is only necessary to wire column 5(x) of the add brushes to a counter and column 10(y) of the add brushes to another counter. These two counters should be set to take progressive totals. In order to insure the correct progressive repetition of each digit on column 10 it is necessary to insert blank cards where a digit is missing as is 8. In this way are recorded the values of $C(x_y)$ and $C(y_y)$ where x_y represents the sum of all the x's having a given value of y and y_y represents the sum of all the y's having a given value of y. Thus in Table I the x_y entry for $y=9$ is $1(3)+1(4)+1(5)+1(6)=18$ while the corresponding y_y entry is $(9)(4)=36$. $C(x_y)$ and $C(y_y)$ indicate that the values x_y and y_y are cumulated with the progressive totals feature of the machine.

The size of the totals, machine capacity, and available attachments determine how much of the running can be completed in one operation.

The last entries in the last three columns of Table I give respectively $\Sigma f=123$, $\Sigma x=542$, $\Sigma y=341$ from which $M_x=4.41$ and $M_y=2.77$ are readily obtained. The standard deviations and the correlation coefficient may be obtained by the use of an adaptation of the Mendenhall-Warren-Hollerith correlation technique.[1]

The values Σxy and Σy^2 are obtained from the formulas

$$\sum xy = \sum_{y=1}^{9} C(x_y) = 413 + 326 + \cdots + 18 = 1427$$

$$\sum y^2 = \sum_{y=1}^{9} C(y_y) = 341 + 323 + \cdots + 36 = 1599.$$

[1] Warren, Richard and Mendenhall, Robert M. The "Mendenhall-Warren-Hollerith Correlation Method." Columbia University Statistical Bureau, Document No. 1. Columbia University, New York City, N.Y. 43 pp.

See also Warren, Richard and Mendenhall, Robert M. "Computing Statistical Coefficients from Punched Cards," *Journal of Educational Psychology* 21(1930), 53–62.

According to the Mendenhall-Warren-Hollerith correlation method, it is necessary to re-sort the cards for x and record $C(x_x)$ and, for checking purposes $C(y_x)$. Then

$$\Sigma x^2 = \Sigma C(x_x) \text{ and } \Sigma xy = \Sigma C(y_x)$$

It is possible however to get Σx^2 from Table I directly since

$$\Sigma x^2 = 11(1)^2 + 15(2)^2 + 16(3)^2 + \cdots + 10(9)^2 = 3332,$$

and since

$$\sigma_x = \frac{1}{n}[n\,\Sigma x^2 - (\Sigma x)^2]^{1/2},\ \sigma_y = \frac{1}{n}[n\,\Sigma y^2 - (\Sigma y)^2]^{1/2}$$

$$r_{xy} = \frac{n\,\Sigma xy - (\Sigma x)(\Sigma y)}{\{[n\,\Sigma x^2 - (\Sigma x^2)]\ [n\,\Sigma y^2 - (\Sigma y)^2]\}^{1/2}}$$

we have

$$\sigma_x = 2.77,\ \sigma_y = 2.31 \text{ and } r_{xy} = -.096.$$

The corresponding computations could be made for Table II though the range of y would be from 1 to 19.

It is not the primary purpose of this paper to indicate various correlation techniques but rather to present the correlation chart. In so doing, however, we are able at the same time to obtain information which makes possible the determination of the correlation coefficient without additional tabulations. Other methods of obtaining Σx^2 and Σxy are the Mendenhall-Warren-Hollerith Correlation Method indicated above and the progressive digit method described by A. E. Brandt.[2]

It is shown in another paper[3] that

$$\Sigma y^3 = \sum_{y=1}^{9} C(y_y)(2y - 1)$$

so that in Table I

$$\Sigma y^3 = 341 + 3(323) + 5(295) + \cdots = 8903$$

while

$$\Sigma x^3 = 11(1)^3 + 15(2)^3 + 16(3)^3 + \cdots = 23138$$

and by the usual formulae we have

$$\mu_{3:x} = 1.13 \qquad \mu_{3:y} = 6.88$$

$$\alpha_{3:x} = .05 \qquad \alpha_{3:y} = .56$$

[2] Brandt, A. E. "Uses of the Progressive Digit Method." *Practical Applications of the Punched Card Method in Colleges and Universities*. pp. 423–436.

[3] Dwyer, Paul S. "The Computation of Moments with the Use of Cumulative Totals." Published in the current (December 1937) issue of the *Annals of Mathematical Statistics*.

CUMULATIVE FREQUENCIES AND STATISTICAL CONSTANTS DEPENDENT UPON THE POSITION IN THE FREQUENCY DISTRIBUTION

With the same wiring as above it is possible to use the cumulative feature of the tabulator and to obtain simultaneously the cumulative frequencies of *all* the columns of the correlation table. This technique is appropriate when medians, deciles, and other statistical quantities dependent on position, are needed. An illustration is given in the next section in Table V.

THE CASE IN WHICH THE VARIABLE x IS CATEGORICAL

The general methods outlined are applicable to the situation in which the variations in x represent qualitative, rather than quantitative, differences. It is of course necessary that these qualitative differences be coded and punched on the cards.

As an illustration, we use the 1,289 cards containing the records of freshmen students entering nine of the curricula of the University of Michigan in 1935. In Table III the first column represents the coded

TABLE III
MACHINE SHEET FOR CATEGORICAL VARIABLE

y	x									Tot.
	0 LS&A	*1* PM	*2* PL	*3* PD	*4* PB	*5* E	*6* A	*7* P	*8* PE	
8	5		4			2				11
7	17	9	8		3	16	1			54
6	69	17	24	1	9	37	7	1	2	167
5	77	21	39		19	74	6	4	1	241
4	165	38	40	3	56	81	17	4	8	412
3	65	25	23	1	28	44	6		6	198
2	49	22	17	2	15	27		3	2	137
1	11	11	3	1	13	10	1	1	2	53
0	4	2	7	1		2				16
	462	145	165	9	143	293	38	13	21	1289

first semester academic record. The code number 0 represents .00 –.49 grade points, 1 represents .50 –.99 grade points, etc. The successive columns, coded 0 –8, represent students enrolled in Literature, Science and the Arts (General); Pre-medical; Pre-legal; Pre-dental; Pre-

business administration; Engineering; Architecture; Pharmacy; and Physical Education, respectively.

If the cumulative feature of the tabulator is used, the machine records the cumulative frequencies of the respective columns. From these distributions the values of the medians, deciles, etc. are easily obtained. The wiring is identical with that for Table III.

It should be noted that Table IV cumulates the frequencies from the highest grades and not from the lowest grades. Thus the entry, 168, in the LS&A column indicates that there are 168 students in that group

TABLE IV
CUMULATIVE TABULATION OF DATA IN TABLE III

	LS&A	*PM*	*PL*	*PD*	*PB*	*E*	*A*	*P*	*PE*	*Tot.*
8	5		4			2				11
7	22	9	12		3	18	1			65
6	91	26	36	1	12	55	8	1	2	232
5	168	47	75	1	31	129	14	5	3	473
4	333	85	115	4	87	210	31	9	11	885
3	398	110	138	5	115	254	37	9	17	1083
2	447	132	155	7	130	281	37	12	19	1220
1	458	143	158	8	143	291	38	13	21	1273
0	462	145	165	9	143	293	38	13	21	1289

who made 5, 6, 7, or 8 on the coded first semester record. The cumulative frequency distribution which cumulates from the lowest grades up could be obtained by arranging the cards, with reference to column y, in ascending order.

The correlation coefficient is inapplicable to the case of categorical series but for summary purposes it is customary to compute the mean and standard deviation of each of the columns. With some changes in wiring and with no additional sorting it is possible to record a table from which these values are readily obtained. The machine is wired to give $C(x_y)$ instead of $C(f_y)$ for the different values of x. The wiring is changed by removing the Card Count wire and replacing it with the wire from add brush $10(y)$.

The results are recorded in Table V. The values opposite $y=0$ are also the values of Σy. If Table III had not been previously obtained the machine could be wired to give frequencies, (see last row of Table

III), and the results of the run recorded in the row labelled Σf. Σy^2 is obtained by adding the values above $y=0$. The two last rows are obtained from the usual formulae $M_y=\Sigma y/n$, $\sigma_y=[n\Sigma y^2-(\Sigma y)^2]^{1/2}/n$.

TABLE V

TABULATION FOR COMPUTING MEANS AND STANDARD DEVIATIONS

y	x									
	LS&A	*PM*	*PL*	*PD*	*PB*	*E*	*A*	*P*	*PE*	*Tot.*
8	40		32			16				88
7	159	63	88		21	128	7			466
6	573	165	232	6	75	350	49	6	12	1468
5	958	270	427	6	170	720	79	26	17	2673
4	1618	422	587	18	394	1044	147	42	49	4321
3	1813	497	656	21	478	1176	165	42	67	4915
2	1911	541	690	25	508	1230	165	48	71	5189
1	1922	552	693	26	521	1240	166	49	73	5242
$0(\Sigma y)$	1922	552	693	26	521	1240	166	49	73	5242
Σf	462	145	165	9	143	293	38	13	21	1289
Σy^2	*8994*	*2510*	*3405*	*102*	*2167*	*5904*	*778*	*213*	*289*	*24362*
M_y	*4.16*	*3.81*	*4.20*	*2.89*	*3.64*	*4.23*	*4.37*	*3.77*	*3.48*	*4.07*
σ_y	*1.47*	*1.67*	*1.73*	*1.73*	*1.38*	*1.50*	*1.17*	*1.47*	*1.29*	*1.53*

APPLICATION TO MULTIPLE PUNCHED COLUMNS

The method can be used similarly when multiple punches occur in the x columns. The code for column 5 of the 1,289 cards is:

0	Sex	Male
1		Female
2	Residence	Michigan
3		Outside Michigan
4	Preparatory School	Public
5		Private
6	Action at Entrance	Probation Only
7		Deficiency Only
8		Probation and Deficiency

The frequencies of these groups, for different first semester grades, are presented in Table VI. It is to be noticed that the "totals" column is composed of the first two groups, (0, 1), the next two groups, (2, 3),

the next two groups, (4, 5), but *not* the last three groups since only a small proportion of the students were admitted to college on probation or with deficiencies in credits.

TABLE VI
TABULATION INVOLVING MULTIPLE PUNCHING

	Sex		*Residence*		*Prep. School*		*Action at entrance*			
	0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*Tot.*
8	9	2	7	4	10	1				11
7	40	14	24	30	51	3		3		54
6	112	55	80	87	154	13		6	1	167
5	184	57	106	135	228	13	1	12	1	241
4	276	136	196	216	374	38	1	14		412
3	145	53	103	95	170	28	5	15		198
2	102	35	69	68	122	15	2	10		137
1	42	11	31	22	45	8	2	3		53
0	13	3	12	4	15	1				16
Tot.	*923*	*366*	*628*	*661*	*1169*	*120*	*11*	*63*	*2*	*1289*

Tables similar to IV and V could be constructed in this case if one desired to discover position statistics or to compute the values of the means and sigmas for the different groups.

CONCLUSION

We have shown how the correlation table can be printed on a tabulator equipped with digit selection and how, at the same time, information can be obtained which permits a speedy calculation of means, sigmas, correlations, and skewnesses. In addition we have shown how the various cumulative distributions can be simultaneously printed and how the means and sigmas of different categories may be obtained.

This is superior in many ways to the card counting sorter method of obtaining these distributions, since it eliminates all probability of error of transcribing and reduces the human element to a minimum.

APPENDIX

The "Digit Pick-up" is wired to control brush #5 (x variable) and the "Digit selector outlet Hubs" 0 to 9 are wired to the 10 "D" Hubs of a 10-Position X-Distributor. (If the machine is equipped with only

a 5-position X-Distributor it will be necessary to make *two* runs through the machine in order to complete the table). If the totals run over 3 places it will be necessary to use a 56 counter alphabetic, or run the cards twice. The alphabetic tabulator is preferable since on the numerical tabulator it is difficult to lock out the zeros.

A "Card Count" plug is wired into the "C" hubs of all 10 X-Distributors, and is also wired directly into the "Total" counter.

The machine is set to take minor totals controlling on column 10 and distributing a card count impulse to 11 counters as described.

REVISED METHOD OF CALCULATION OF THE WHOLESALE PRICE INDEX OF THE UNITED STATES BUREAU OF LABOR STATISTICS

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I. INTRODUCTION

The United States Bureau of Labor Statistics official series of index numbers of wholesale prices dates from 1890.[1] In the construction of the index, there have been employed from time to time differing methods of computation. Such revisions are essential. As improved methods are developed, and as circumstances permit, changes must be made in the collection of the basic data and in the construction of index numbers. The Bureau is now engaged in an extensive revision of its wholesale price reporting service. As a part of its revision program, the Bureau has changed the method of calculation of its wholesale price index, introducing a simpler and (it is hoped) a better technique. Further revisions in method and in procedure are under consideration. The main purpose of this discussion is to acquaint the users of the index with the change in method which has now been made. Other changes will be described as they are introduced into the computations.

The wholesale price index number of the Bureau has, since 1908, been computed as a chain index. In August, 1937, however, a revision in the method of computation was completed for the period beginning with January, 1937, and henceforth the index will be computed as a fixed-base index. Both the former chain index and the recently introduced fixed-base index are of the aggregative type. The change in the method of computation, which has had no immediate effect on the level or movement of the index, was undertaken for several reasons. The revised method should theoretically yield better results than the former method, and it has, in addition, a practical advantage of considerable importance.[2]

[1] For index numbers of wholesale prices 1890–1926, see U. S. Bureau of Labor Statistics Bulletin No. 543, *Wholesale Prices, 1930*, (Sept. 1931), Table 1, pp. 3–10; for 1926–1931, see Bulletin No. 572, *Wholesale Prices, 1931* (Jan. 1933) Table 4, pp. 15–16. Figures for subsequent periods are shown in monthly pamphlet, *Wholesale Prices* and in the *Monthly Labor Review*. Mimeographed tables covering entire period available on request from the U. S. Bureau of Labor Statistics, Washington, D. C. By splicing to other series of indexes wholesale price movements may be traced back to 1720; see G. F. Warren and F. A. Pearson, "Wholesale Prices, 1720–1889, inclusive," U.S. Bureau of Labor Statistics Bulletin No. 572, *Wholesale Prices, 1931* (Jan. 1933) pp. 111–114.

[2] The method of computation described in this article was recommended by Henry B. Arthur in his report of December, 1935, to the Committee on Government Statistics and Information Services, "Wholesale Price Work of the Bureau of Labor Statistics." Mr. Arthur has given continuing advice

II. THE FORMER METHOD

The chain index method[3] which has been used for the last 29 years was originally adopted to facilitate substitutions in price series and to simplify the task of making recurring changes in weights. By this method it is a relatively simple matter to provide for the breaks in homogeneity which occur in price series. Models or styles of a commodity become obsolete and cease to be manufactured, and new models and styles are introduced to satisfy the changing demands of a fickle public. Marketing centers shift, and the price at the marketing center formerly of principal importance must be replaced by the price at the marketing center to which the business has moved. Price-quoting practices in an industry change, and prices once quoted f.o.b. give way to delivered prices, or vice versa. Breaks of this sort can be handled in a chain index by securing overlapping price data for no more than a single month, as a direct comparison is made only between the prices for the current month and those of the preceding month. (In practice, however, when a substitution has been made, or when there has been a change in a price series, the Bureau has attempted to secure overlapping prices for a year). The Bureau of Labor Statistics index contains such a large number of price series, the official count having been 784 since the 1931 revision, that breaks in homogeneity are frequent. Consequently there is great advantage in any method by which they may be handled simply.

Furthermore, the chain index has been convenient in effecting the changes in weights which have been made periodically as the Census of Manufactures data have become available. For a dozen years prior to 1934 the revised weights were introduced at two-year intervals. Since 1934, however, no changes in weights have been made, because the weights which would normally have been introduced in 1936 were those relating to the depression years, and they appeared to be un-

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and encouragement which have been exceedingly helpful during the course of the revision. The authors also wish to acknowledge the assistance of the members of the Sub-Committee on Wholesale Prices of the Committee on Prices of the Central Statistical Board, especially Sidney W. Wilcox, Frank R. Garfield, and C. A. Purves.

[3] The chain index used has been computed in accordance with the usual formula, which may be written for the monthly index as follows:

$$I_k = \frac{\Sigma(P_k Q_h)}{\Sigma(P_{k-1} Q_h)} I_{k-1}$$

where I_k = index for the given month
P_k = price for the given month
P_{k-1} = price for the preceding month
I_{k-1} = index for the preceding month
Q_h = quantity at the time h; used as "quantity weight."

A formula of the same type has been used for the weekly and the annual indexes.

representative of the recovery period. At the present time, quantities used as "quantity weights" are averages of the data for 1929 and 1931, except for farm products, for which the quantities used are averages of the data for the three years 1929, 1930, and 1931. (This last statement applies to the revised method as well as to the former method.) When changes in weights were made the revised weights were introduced at the beginning of a calendar year. It was necessary merely to compute for the preceding December two sets of aggregates of the type $\Sigma(PQ)$, one using the former weights for comparison with November, and the other using the revised weights for comparison with January. (For a detailed description of the method, see pp. 2–5, U. S. Bureau of Labor Statistics Bulletin No. 493.) Thus the extra work necessitated by the change in weights was small, and the comparison of each pair of successive months was maintained on a homogeneous basis.

Disadvantages

Although the chain index is convenient in providing for easy substitution of one price series for another, and in facilitating changes in weights, it encounters serious practical and theoretical difficulties. The more important of these are summarized in the four paragraphs below:

1. For any month in which a substitution of one price series for another occurs, there are two cross-products for the commodity affected, one comparable with the preceding month, the other comparable with the following month. As a result, two sets of aggregates are necessary for the groups, and for the composite index. Thus the cross-products for individual commodities, and the aggregates for subgroups, groups, and the composite index are not comparable over any extended period. Because of this non-comparability of existing cross-products and aggregates, it is very difficult to compute for a past period any special index in which series are combined into groups different from the standard classification. Essentially a recomputation of the whole index from the original price and quantity data is required. Since the need for special comparisons of this sort is rather frequent, the burden of clerical work has been heavy.

2. The relative importance of a commodity in the index is often changed by the substitution of one price series for another relating to the same commodity. Such a change in relative importance occurs whenever the price level of the new series differs from that of the former series, since the same "quantity weight" is used in both cases. Examples of changes in relative importance of particular commodities are quite numerous, though such changes ordinarily have not been

large. Of the 15 substitutions in 1936 of one price series for another, there were 11 where the relative importance of the commodity changed. The greatest individual relative change was in the case of "harvester-threshers," where in the month preceding the substitution the new series was 26.4 per cent above the former series. A substitution became necessary in January, 1936, because the manufacture of the earlier model was discontinued. The price of the old model for January was $1,008.75, the "quantity weight," expressed in thousands, 15, yielding a cross-product of 15,131. Since the aggregate of all such cross-products for the agricultural implements subgroup was 205,387, harvester-threshers before the substitution represented 7.4 per cent of the entire subgroup. The price of the new model for January was $1,275.00 and the product of price by 15, the "quantity weight," was 19,125. The aggregate of all the cross-products for the agricultural implements subgroup, including the new cross-product for harvester-threshers, was 209,381. After the substitution of the new series, therefore, harvester-threshers represented 9.1 per cent of the subgroup total, as compared with 7.4 per cent noted above. In the case of storage batteries, the difference in the price levels of the new series and the former series was not so great, amounting to 23.0 per cent; the effect on the composite index, however, was greater, since the cross-product for storage batteries changed by 16,048, from 69,856 to 53,808 while the cross-product for harvester-threshers changed by only 3,994, expressed in thousands of dollars. The size of the cross-products is, of course, a measure of the relative importance of commodities in the index.

3. Comparison of indexes computed by the chain method for any two weeks or months does not in general give the same result as would be secured by a direct comparison of the prices in the two periods. This difference in the results arises even within a period during which no general change in weights has been made.

4. The method of computation employed for the chain index implies that each price series used is appropriate for multiplying by the established "quantity weight" to obtain a meaningful value aggregate. In other words, it is assumed that the particular grade and market represented by the price series used in the index provides a price near enough the average for the whole industry so that it can be multiplied by the number of units to give a valid measure of the commodities' total value. In fact, this is not always the case, even where no substitutions have been made. Moreover, a substitution which changes the level of the price series would, as has been pointed out above, render the multiplication no longer appropriate, even though the original price and quantity figures could appropriately be multiplied.

III. THE REVISED METHOD

The method recently adopted for the computation of the Bureau of Labor Statistics' wholesale price index is the customary weighted aggregate method, with a fixed base.[4] When a substitution in an individual price series is made, the new series is adjusted to the level of the former series, so that the cross-product and the aggregate remain comparable with corresponding cross-products and aggregates for preceding periods. In practice, this is accomplished by adjusting the "quantity weight" (Q_h).

For example, a substitution occurred in the price of currants in January, 1937, when the "Patras" series replaced the "Amalia" series. The discontinued series showed a price of 11.0 cents per pound for December, 1936, and the substitute series a price of 11.5 cents per pound for the same month. Examination of the nature of the two series and of their movements during the preceding five years, as shown on the top section of the chart, indicated that the relationship existing in December was typical. The ratio, 11.0/11.5=.95652, therefore, measures the size of the adjustment to be made in the new series in order to maintain comparability with the former series. The adjustment might have been made by multiplying the price for each month after December by the ratio, and then multiplying by the "quantity weight," 8,215, expressed in thousands, to obtain the cross-product necessary for the index. It has been simpler, however, to make a single multiplication of the "quantity weight" by the ratio found above. This yields 8,215×.95652=7,858. The new multiplier 7,858 is used for subsequent months.

As a result of the adjustment made in the quantity figure, the number used to multiply the price series ceases (after a substitution) to have significance as a quantity.[5] It becomes a convenient *multiplier*,

[4] The formula may be written as follows:

$$I_h = 100\frac{\Sigma(P_hQ_h)}{\Sigma(P_0Q_h)}$$

Where I_h = index for the given month
P_h = price for the given month
P_0 = price for the base year (1926)
Q_h = quantity at the time h.

For the purpose of comparison the formula previously used is repeated here as follows:

$$I_h = \frac{\Sigma(P_hQ_h)}{\Sigma(P_{h-1}Q_h)}I_{h-1}$$

In using these formulae it should be noted that Q_h in the former method represents an actual quantity. In the revised method Q_h represents an actual quantity except in case of a substitution when it ceases to have significance as a quantity.

[5] Adjustment of the quantity figure raises certain problems in connection with the computation of an average price for a group of series. Computation of such an average price is rarely appropriate,

which keeps the relationship between the cross-product for the commodity involved in the substitution and the aggregate for the subgroup or group the same as before the substitution.

The introduction of the fixed-base method requires, of course, the computation of a comparable aggregate $\Sigma(P_0Q_h)$ for the base year, for each subgroup and group and for the composite index. On account of the general changes in weights which have been made since the base year (1926), and because of the substitutions in price series which have occurred, it was not feasible to compute these base aggregates directly. Therefore, the base aggregates used were obtained by dividing the aggregates for December, 1936, by the index numbers for the same month, which it will be recalled are on the 1926 base. The aggregates thus found preserve the comparability of the indexes computed by the revised method with indexes computed by the former method.

The computation of the base aggregate for the "grains" subgroup illustrates the method which was followed. The aggregate for the "grains" subgroup for December, 1936, was 1,548,616, in thousands of dollars. The index for this subgroup for the same month was 109.00, on the 1926 base. The aggregate for the base year 1926 was calculated by dividing 1,548,616 by 109.00 and multiplying by 100, thus obtaining 1,420,749. This base aggregate was then used to divide the aggregate for the subgroup for each month after December, 1936, in order to obtain the corresponding subgroup index. Obviously, division of the aggregate for December, 1936, (1,548,616) by the base aggregate 1,420,749 and multiplication of the result by 100, yield the original index for December (109.00). Since aggregates for months following December have been made comparable with the aggregate for December, indexes for these months are likewise comparable with the December index.

Appraisal of Revised Method

The revised method of computation escapes the serious practical difficulty and avoids several, though not all, of the theoretical diffi-

because the units are usually heterogeneous. In some cases, however, it may be proper. For example, an average might be computed for the 18 butter series. In such instances, before any substitutions, the average price would ordinarily be obtained by dividing the aggregate of the cross-products for the group by the sum of the "quantity weights." After a substitution, one of several procedures might be followed, depending upon the purpose and upon the circumstances. If an average price comparable with preceding average prices were desired for the purpose of indicating price changes from one period to another, the aggregate of the cross-products should be divided by the sum of the unadjusted "quantity weights." If, on the other hand, an average price is desired to indicate as precisely as possible the level of prices for the commodity at a single time, a different divisor would probably be necessary. The aggregate might be divided by the sum of the adjusted "quantity weights," or an entirely new computation might be made.

culties inherent in the former method. Its success in dealing with these problems is outlined in the five paragraphs below:

1. Since the essence of a fixed base index is a series of comparable cross-products and aggregates, the regrouping of commodities into special combinations is a relatively simple matter. In this practical respect, the advantage over the chain index is significant.

2. The relative importance of a commodity is unaffected by the substitution of one price series for another, no matter how much difference there may be between the levels of the two series. In this respect, the revised method is eminently successful.

3. The revised index will not in general give the same result for a given month as would be secured by comparing the prices in that month directly with prices in the base period. This situation arises because of the changes in weights which have been made since 1926, and because of the use of the former method until the end of 1936; it is not a result of the type of index. Within the period of use of the revised method, at least until another change in weights is made, the comparison of any two months on the 1926 base will yield the same result as would be secured by comparing prices in one month directly with prices in the other.

4. Where the original price series could appropriately be multiplied by the quantity figure derived from Census data, the fixed-base index maintains the appropriateness of the multiplication even though substitutions are made. Where the multiplication was not appropriate in the first instance, this index maintains the inappropriateness. This problem is essentially associated with the aggregative form of index.[6] It is a problem to which the Bureau of Labor Statistics intends to give consideration during the current program for revision and expansion of its wholesale price reporting service.

5. As the accompanying table indicates, the differences between indexes computed in accordance with the former method and those using the revised method have been so small during the period since January, 1937, that the advantage of the revised method on theoretical grounds is not demonstrated. Over a longer period, however, differences between the results of the two methods are almost certain to arise, and may prove substantial for some of the subgroups and groups. In such cases, the results of the revised method should be more satisfactory, because in the revised method the relative importance of a commodity

[6] For a discussion of this point see H. B. Arthur, "Weighted Aggregates and Index Numbers," THIS JOURNAL. 32 (1937), 362.

is unaffected by substitutions, while in the former method the relative importance of a commodity could be changed.

Introduction of Revised Method into Computation

The revised method was introduced into the monthly index with the computation of the figure for July, 1937, and its use has been extended back to January, 1937. Comparable aggregates thus exist for each month beginning with December, 1936. The differences in the results obtained by the former method and by the revised method have been so small during the period of overlap that a direct substitution has been possible. The effect on a group index, rounded to the nearest tenth of a per cent, was in no case more than 0.1 per cent. The greatest difference for any subgroup index was 0.4 per cent.

The introduction of the revised method into the weekly index has not been completed at the time of writing. It is expected, however, that the weekly indexes will be currently computed in accordance with the revised method before the end of 1937, and that the computation will be extended back for a brief period before the date of introduction. When the revised method of computation is introduced into the weekly index, there will be a slight break in homogeneity in the composite index and in most of the group indexes. As a result of the chain method, the weekly indexes have wandered away slightly from the monthly index, though the largest discrepancy for any group is at the present time only 1.8 per cent. When the revised method of computation is introduced, the weekly indexes will be brought to the level of the monthly indexes, and should in the future remain at approximately the same level as the monthly indexes. The divergencies that may arise from time to time should be small in amount and random in direction.

IV. TECHNIQUE OF SUBSTITUTION

The substitution of one price series for another may properly be made only where it is clear that the two series relate to the same market (in the broad sense). In all cases where a series is discontinued, therefore, it is necessary to investigate the discontinued series together with any series that may be available as possible substitutes. The object of this investigation is to determine the precise market to which the discontinued series related, and to select a substitute series which represents the same market. In any case in which a former series has become non-representative of the market which it was originally intended to describe, it may be necessary to introduce the new series at some date previous to that at which the necessity for substitution

arose, and to make corresponding revisions in the indexes for intervening months.

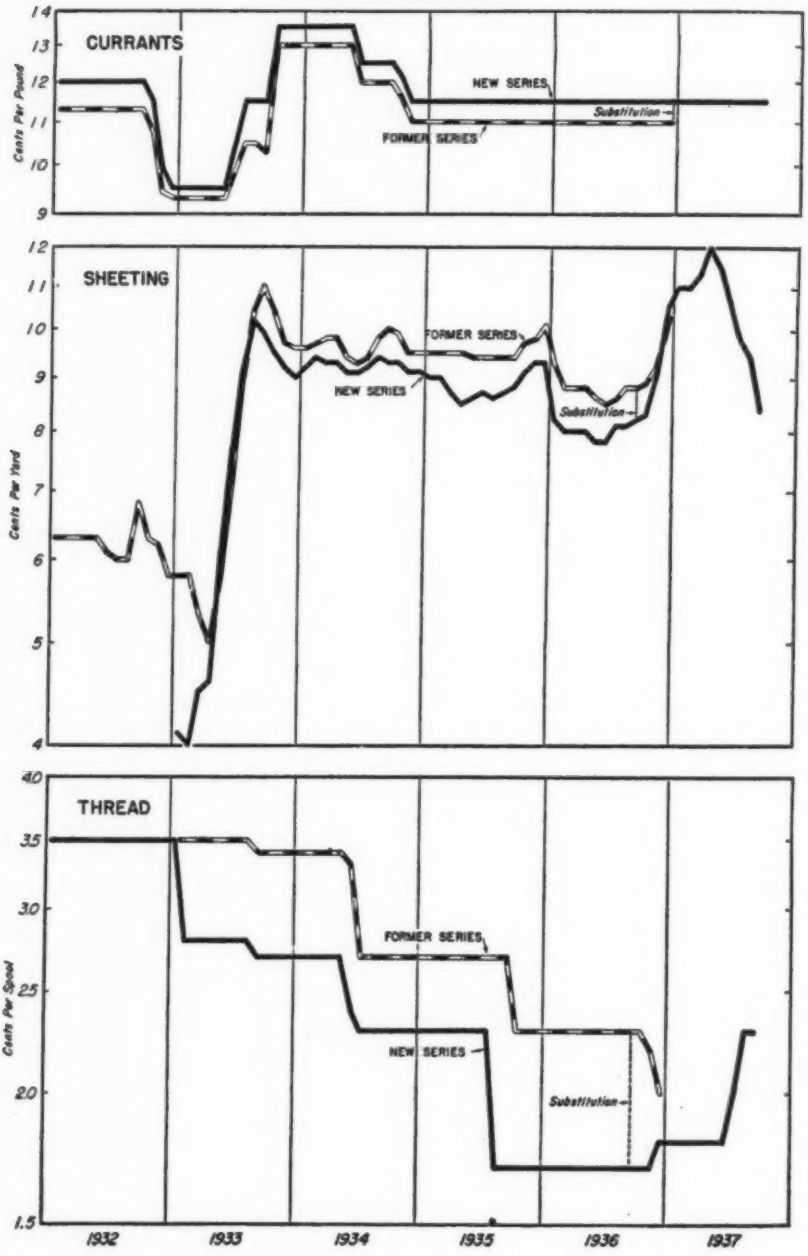
When a satisfactory substitute series has been selected, the adjustment of the quantity multiplier to take account of the substitution should, of course, be made on the basis of the typical relationship between the two series.

The substitutions that had been made in accordance with the former method of computation between January and July, 1937, were reexamined to assure their validity, and all were found to be satisfactory. Consequently each pair of series was tested to determine the typical relationship. A semi-logarithmic chart was drawn comparing the two series for the period beginning with January, 1932, or for as much of this period as both were available. In almost all cases, graphic inspection showed a reasonably consistent relationship between the two series concerned. Price fluctuations came at the same, or nearly the same, times and were of approximately the same magnitude in the two series. Where this condition existed, and where the price-spread in the last month before the substitution appeared to be about the same as that during the entire period, the last month was used as the basis for computing the ratio of the substitute series to the former series. An adjustment based on a single month may be theoretically objectionable, but the objections should be largely answered by the use of a single month only where it is apparently typical. Moreover, use of a single month creates no problem of a break at the time of substitution, which might occur if a broader period were used as the basis for the adjustment. Finally, the use of a single month reduces the amount of revision of back data, and requires less clerical work than use of a broader period.

In several cases (mainly among the furniture items) overlapping price data could be obtained for no more than a single month. Here, apparently, when one style is replaced by another the process is abrupt, and the old styles are withdrawn completely as soon as the new are placed upon the market. An examination of the spread during previous months could not be made, and the single month of overlap was necessarily accepted as typical. It is hoped that in the approaching revision of the furniture series, a more satisfactory treatment of this problem of style changes can be developed; but in the meantime no other solution was possible.

In most cases, the last month before the substitution could properly be taken as providing a typical spread between the two series. However, there were a few instances in which this was not possible. A situation which will probably occur fairly frequently was found in the case

WHOLESALE PRICES OF SELECTED COMMODITIES
Monthly 1932–1937
(Logarithmic vertical scale)



of cotton sheeting. The Bureau had been quoting prices on an unbleached sheeting with a thread count of 64×64, running 3.72 yards to the pound. The reporting of this series was discontinued by the manufacturer, and a substitute series of prices was selected for a different grade of sheeting with a thread count of 64×68, running 3.50 yards to the pound. From late 1933 until October, 1936, as the accompanying chart shows, the price of the substitute series was consistently below the price of the discontinued series by a nearly constant relative

COMPARISON OF INDEX NUMBERS OF WHOLESALE PRICES USING THE FORMER METHOD OF COMPUTATION AND THE REVISED METHOD OF COMPUTATION

By Groups of Commodities, January to May 1937, Inclusive
(1926 = 100)
Column (a) Former Method
Column (b) Revised Method

Groups	January		February		March		April		May	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
All commodities	85.90	85.93	86.27	86.27	87.77	87.76	87.97	87.91	87.38	87.37
Farm Products	91.49	91.52	91.38	91.41	94.05	94.11	92.20	92.19	89.76	89.75
Foods	87.08	87.07	86.98	86.98	87.53	87.53	85.46	85.46	84.18	84.17
Hides & leather products	101.71	101.74	102.72	102.75	104.17	104.19	106.30	106.32	106.70	106.73
Textile products	77.50	77.50	77.50	77.50	78.28	78.24	79.55	79.55	78.74	78.73
Fuel & lighting materials	76.59	76.59	76.77	76.76	76.16	76.15	76.34	76.33	77.17	77.06
Metals & metal products	90.91	90.91	91.71	91.71	95.99	95.98	96.55	96.55	95.79	95.79
Building materials	91.32	91.33	93.29	93.30	95.86	95.88	96.72	96.74	97.16	97.18
Chemicals & drugs	87.69	87.69	87.75	87.75	87.54	87.54	86.92	86.92	84.46	84.46
Housefurnishing goods	86.64	86.59	87.92	87.87	88.44	88.39	88.95	88.97	89.30	89.32
Miscellaneous	76.16	76.15	77.26	77.23	79.46	79.41	81.10	81.05	80.55	80.50

NOTE: The indexes are presented here to hundredths for more exact comparison of the two methods. In official publications the indexes are given to tenths, as the significance of the second decimal is doubtful.

amount. From that time on, both series rose quite vigorously, but the substitute series rose much farther than the discontinued series, so that it was actually above the discontinued series in December, the last month in which the discontinued series was quoted. On investigation, it was learned that the former series was no longer being manufactured. In order to close out remaining stocks at a time when the market for cotton goods was rising very rapidly, the price of the former series was advanced more slowly than the prices of similar goods. The price rise of the substitute series was definitely a better measure of the market at the time. Consequently, December, 1936, could not properly be used

as the overlap period. The index was therefore revised back through October, 1936, introducing the substitute series in that month. Since the aggregates have been made comparable only beginning with December, the substitution was made by the chain method, and the quantity multiplier was not changed. If an adjustment of the quantity multiplier had been made, however, it would have been done on the basis of September, 1936.

A second series that raised a problem is presented in the bottom section of the chart. The former series for cotton thread was reported to the Bureau as an unweighted average of the prices for 8 to 200 ticket. The substitute series was reported as an unweighted average of the prices of 40, 50, and 60 ticket only, which represent the bulk of the total business. Although the sizes of thread included in the substitute series were also included in the former series, the two series had peculiar differences in movement. No typical spread appeared. However, since the upward movement shown by the substitute series between November, and December, 1936, was a better measure of the price change for cotton thread than the downward movement of the former series between October and December, it was decided to make the substitution in October, 1936, revising the index back to that time. As in the case of cotton sheeting, no adjustment in the multiplier was made; if an adjustment had been made, it would have been on the basis of the overlap in September.

THE USE OF RANKS TO AVOID THE ASSUMPTION OF NORMALITY IMPLICIT IN THE ANALYSIS OF VARIANCE

By Milton Friedman
National Resources Committee

Most projects involving the collection and analysis of statistical data have for one of their major aims the isolation of factors which account for variation in the variable studied. The statistical tool ordinarily employed for this purpose is the analysis of variance. Frequently, however, the data are sufficiently extensive to indicate that the assumptions necessary for the valid application of this technique are not justified. This is especially apt to be the case with social and economic data where the normal distribution is likely to be the exception rather than the rule. This difficulty can be obviated, however, by arranging each set of values of the variate in order of size, numbering them 1, 2, and so forth, and using these ranks instead of the original quantitative values. In this way no assumption whatsoever need be made as to the distribution of the original variate.

The utilization of ranked data is thus frequently a desirable device to avoid normality assumptions; in addition, however, it may be inescapable either because the data available relate solely to order, or because we are dealing with a qualitative characteristic which can be ranked but not measured.

The possibility of using ranked data in problems involving simple correlation and thereby avoiding assumptions of normality has recently been emphasized in an article by Harold Hotelling and Margaret Richards Pabst.[1] It is the purpose of the present article to outline a procedure whereby the analysis of ranked data can be employed in place of the ordinary analysis of variance when there are two (or more) criteria of classification. This procedure has two major advantages. As already indicated, it is applicable to a wider class of cases than the ordinary analysis of variance. In addition, it is less arduous than the latter technique, requiring but a fraction as much time. The loss of information through utilizing the procedure outlined below when the analysis of variance could validly be applied may thus be more than compensated for by its greater economy. This consideration is likely to be especially important with those large scale collections of social and economic data which have become increasingly frequent in recent years and for which the funds available for analysis are limited.

[1] "Rank Correlation and Tests of Significance Involving No Assumption of Normality," *Annals of Mathematical Statistics*, VII (1936) 29–43.

THE PROCEDURE

The procedure, which I shall call the *method of ranks*, involves first ranking the data in each *row* of a two-way table and then testing to see whether the different *columns* of the resultant table of ranks can be supposed to have all come from the same universe. This test is made by computing from the mean ranks for the several columns a statistic, χ_r^2, which tends to be distributed according to the usual χ^2 distribution when the ranking is, in fact, random, i.e., when the factor tested has no influence.

The details of the procedure can best be explained by presenting an example. Table I gives the standard deviations of expenditures on different categories of expenditure for seven income levels.[2] It is de-

TABLE I

STANDARD DEVIATIONS AT DIFFERENT INCOME LEVELS* OF EXPENDITURES ON THE MAJOR CATEGORIES DURING 1935–36 OF 246 MINNEAPOLIS AND ST. PAUL FAMILIES OF WAGE-EARNERS AND LOWER SALARIED CLERICAL WORKERS†

Category of expenditure	Annual family income						
	$750–1,000	$1,000–1,250	$1,250–1,500	$1,500–1,750	$1,750–2,000	$2,000–2,250	$2,250–2,500
Housing	$103.3	$68.42	$89.53	$77.94	$100.0	$108.2	$184.9
Household operation	42.19	44.31	60.91	73.90	43.87	61.74	102.3
Food	71.27	81.88	100.71	86.52	100.3	90.75	100.6
Clothing	37.59	60.05	56.97	60.79	71.82	83.04	117.1
Furnishings and equipment	58.31	52.73	96.04	60.42	104.33	89.78	85.77
Transportation	46.27	82.18	129.8	181.0	172.33	164.8	246.8
Recreation	19.00	23.07	38.70	45.81	59.03	50.69	55.18
Personal care	8.31	8.43	9.16	14.28	10.63	15.84	12.50
Medical care	20.15	33.48	60.08	69.35	114.34	45.28	101.6
Education	3.16	4.12	12.73	18.95	8.89	41.52	66.33
Community welfare	4.12	18.87	8.54	12.92	25.30	19.85	16.76
Vocation	7.68	11.18	10.44	10.95	10.54	13.96	14.39
Gifts	5.29	10.91	11.22	25.26	42.25	48.80	69.38
Other	6.00	5.57	22.23	2.45	6.24	1.00	4.00

* In computing the standard deviations the influence of family composition (in terms of number of members and their age) was eliminated by grouping the families at each income level into similar family types and computing the sums of squares within such income-family type groups. These sums of squares were summed for the family types at each income level and divided by the number of degrees of freedom. This gave the variance at each income level. It is the square roots of the variances which are entered in the table.

† The figures in this table are based on schedules collected by the Cost of Living Division of the U. S. Bureau of Labor Statistics. These schedules were loaned to the National Resources Committee for special analyses, of which this is one.

[2] The figures given in Table I were obtained from schedules on the receipts and disbursements of families of wage earners and lower salaried clerical workers during 1935–36 collected in Minneapolis and St. Paul by the Cost of Living Division of the U. S. Bureau of Labor Statistics. These schedules were loaned to the National Resources Committee for special analyses, several of which are used in this article.

sired to determine whether the standard deviations differ significantly for the different income levels.

The first step is to form Table II from Table I by ranking the standare deviations for each category, giving the lowest value a rank of 1,

TABLE II

RANKING OF INCOME LEVELS BY SIZE OF STANDARD DEVIATION FOR EACH CATEGORY OF EXPENDITURE*

Category of expenditure	Annual family income						
	$750–1,000	$1,000–1,250	$1,250–1,500	$1,500–1,750	$1,750–2,000	$2,000–2,250	$2,250–2,500
Housing	5	1	3	2	4	6	7
Household operation	1	3	4	6	2	5	7
Food	1	2	7	3	5	4	6
Clothing	1	3	2	4	5	6	7
Furnishings and equipment	2	1	6	3	7	5	4
Transportation	1	2	3	6	5	4	7
Recreation	1	2	3	4	7	5	6
Personal care	1	2	3	6	4	7	5
Medical care	1	2	4	5	7	3	6
Education	1	2	4	5	3	6	7
Community welfare	1	5	2	3	7	6	4
Vocation	1	5	2	4	3	6	7
Gifts	1	2	3	4	5	6	7
Other	5	4	7	2	6	1	3
a. Total	23	36	53	57	70	70	83
b. Mean rank	1.643	2.571	3.786	4.071	5.000	5.000	5.929
c. Deviation	−2.357	−1.429	−.214	.071	1.000	1.000	1.929

Sum of squared deviations = 13.3692

$\chi_r^2 = 40.108$

* The figures in this table are derived from Table I.

the next lowest rank of 2, etc.[3] Thus, in each row of Table II, we have a set of numbers from 1 to 7, since there are seven income levels.

On the hypothesis that for any one category the value of the standard deviation is the same at all income levels, differences among the values in each row of Table I will arise solely from sampling fluctuations. The rank entered for a particular income level would then be a matter of chance; in repeated samples each of the numbers from 1 to 7 would appear with equal frequency.[4]

[3] It is, of course, immaterial whether the ranking is from the lowest to the highest or the reverse, i.e., from the highest to the lowest.

[4] This statement is strictly valid only if the different entries in the same row are assumed to come from the same universe—no matter, of course, what its nature. In the present example it requires some qualification since the standard deviations in each row are not all based on the same number of cases. In this case, while two entries in the same row of the original table (e.g., Table I) will have the same expected value, one will exceed the other more than half the time. The reason for this is that the

If, therefore, the standard deviation were independent of the income level, the set of ranks in each *column* would represent a random sample of 14 items (that being the number of categories of expenditure) from the discontinuous rectangular universe—1, 2, 3, 4, 5, 6, 7. The mean of this universe is 4, or, in general, $\frac{1}{2}(p+1)$, where p is the number of ranks. The variance is also 4, or in general $(p^2-1)/12$.[5]

The next step in the procedure is to obtain the mean rank for each column. These are given on line b of Table II. In the absence of a relation between the standard deviations and income level, these means are all estimates of the same thing, namely of the mean of the rectangular universe. Moreover, the sampling distribution of the means will be approximately normal so long as the number of rows is not too small.[6]

The sampling distribution of the mean ranks (where $\bar{r}_j$ is the mean rank of the j-th column) will have a mean value (ρ) of $\frac{1}{2}(p+1)$ and a variance σ^2 of $(p^2-1)/(12\,n)$, where n is the number of rows, i.e., the number of ranks averaged.[7]

Since the true mean and true standard deviation of the chance universe are known, the hypothesis that the means come from a single homogeneous normal universe can be tested by computing

$$\chi_r^2 = \frac{p-1}{p\sigma^2}\sum_{j=1}^{p}(\bar{r}_j-\rho)^2 = \frac{12n}{p(p+1)}\sum_{j=1}^{p}\left\{\bar{r}_j-\tfrac{1}{2}(p+1)\right\}^2 .$$

sampling distribution of the ratio of two variances is not symmetrical unless both variances are based on the same number of degrees of freedom. The mean value of the ratio is approximately unity, but the median is not equal to one—it is less than one if the numerator is based on fewer degrees of freedom than the denominator, and conversely. In ranking *two* standard deviations, therefore, the one based on the smaller number of cases would receive a rank of 1 more than half the time. When more than two standard deviations are ranked this tendency is somewhat compensated for by the greater probability that those based on the fewest cases will receive relatively high ranks, and thus the average rank will be less affected. This difficulty does not, however, affect the validity of the illustrative analysis presented here, since the two highest income classes contain the smallest numbers of families but have the highest average ranks.

More generally, when the entries in different columns of the same row come from symmetrical universes with the same mean but different variances, the several ranks will have the same *expected* value, but the probability distribution for each cell will not be exactly rectangular. This condition of symmetry is a sufficient condition for the ranks to have the same expected value; it is, however, more stringent than is necessary. This difficulty clearly calls for further analysis.

[5] The sum of the numbers from 1 to p is $\frac{1}{2}p(p+1)$. The mean is therefore $\frac{1}{2}(p+1)$. The sum of the squares of the numbers from 1 to p is $(2p+1)(p+1)p/6$. The variance is, therefore, $(2p+1)(p+1)/6 - \frac{1}{4}(p+1)^2 = (p^2-1)/12$.

[6] That the sampling distribution of samples drawn from a rectangular universe approaches normality quite rapidly is, of course, well known. The distribution of means for samples of two is a triangle; for samples of three it is made up of three parabolic segments, the first and third concave upwards, and the middle one concave downward. An empirical distribution for samples of ten is given by Hilda Frost Dunlap, "An Empirical Determination of the Distribution of Means, Standard Deviations and Correlation Coefficients Drawn from Rectangular Populations," *Annals of Mathematical Statistics*, II (1931), 66–81. The universe sampled was a discontinuous rectangular universe, including the integers from 1 to 6. The empirical distribution shows extremely close conformity to the normal curve.

[7] This follows from the fact that the variance of a mean of n observations of equal weight is $1/n$ times the variance of an individual observation.

So long as the number of rows and columns is not too small, χ_r^2 computed in this way will be distributed according to the usual χ^2 distribution with $p-1$ degrees of freedom.[8] If, now, χ_r^2 is significantly greater than might reasonably have been expected from chance, the implication is that the mean ranks differ significantly, i.e., that the size of the standard deviation depends on the income level.

The computation of χ_r^2 is extremely simple. The mean of the seven mean ranks is, of necessity, equal to the true mean of 4. The difference between the mean rank for each column and 4 is given on line c of Table II. The sum of the squares of these differences is 13.3692 and $\chi_r^2 = 40.1076$.

This illustrative computation has been made using a formula that makes clear the nature of χ_r^2. In actual practice the following alternative formula which involves only integers and makes unnecessary the computation of the actual mean ranks will be found more convenient:

$$\chi_r^2 = \frac{12}{np(p+1)} \sum_{j=1}^{p} \left(\sum_{i=1}^{n} r_{ij} \right)^2 - 3n(p+1),$$

where r_{ij} is the rank entered in the i-th row and j-th column.

The number of degrees of freedom on which this estimate is based is $p-1=6$. For six degrees of freedom the value of χ^2 which would be exceeded by chance once in 20 times is 12.592, and once in a hundred times, 16.812.[9] The probability of a value greater than 40 is .000001.[10] There can thus be little question that the observed mean ranks differ significantly, i.e., that the standard deviation is related to the income level. From the mean ranks it is seen that with but one minor exception the standard deviations consistently increase with income.

Since the value of χ_r^2 is invariant under transpositions of the columns of ranks under their captions this information—that the ranks increase with income—has not been utilized. Whenever the columns themselves can be ranked, the additional information supplied by the relationship between the order of the mean ranks and the order of the columns can be used by computing a rank difference correlation between the two corresponding sets of ranks, determining the probability that the correlation coefficient obtained would have been equalled or exceeded by chance, converting this probability into the value of χ^2

[8] For a justification of the formula for χ_r^2 and of the statement that χ_r^2 tends to be distributed like χ^2, as well as for some indication of the number of columns and rows necessary, see pp. 687–694 and the mathematical appendix.

[9] Fisher, R. A., *Statistical Methods for Research Workers*, Table III.

[10] Pearson, Karl, *Tables for Statisticians and Biometricians*, 3rd Edition, London, 1930, Part, I Table XII.

which corresponds to it for two degrees of freedom, and pooling the resultant value of χ^2 with χ_r^2.[10a] In the present illustrative example the evidence is so clear that this additional information will obviously not affect the conclusion. It will, however, serve to exemplify the procedure. The rank difference correlation between the mean rank and the income level is .991. (In deriving this coefficient the tied ranks were treated in the manner suggested below, i.e., they were assigned the average value of the ranks for which they were tied.) The probability of securing a value as great as or greater than this is between .00277 and .00040. The value of χ^2 corresponding to the larger of these figures for two degrees of freedom is $-2 \log_e .0277 = 11.77$. Adding this to χ_r^2 gives 51.88 as the value to be entered in the χ^2 table for 8 degrees of freedom. The probability associated with this value is smaller than that for χ_r^2 and, indeed, is so small that it cannot be determined from the published tables.

In order to test whether the standard deviations are related to the type of expenditure it is only necessary to repeat the above analysis; this time, however, treating the columns is the way in which the rows were previously treated, and *vice versa*. Thus the standard deviations would be ranked for each income level, and the mean ranks obtained for each type of expenditure.

It might appear offhand as if the procedure used to study the relation between standard deviations and income level does not make use of all of the information provided by Table II, that it neglects the distribution of the ranks within the columns, and that this supplies additional information about the consistency of the ranking. This, however, is not the case. Since Table II must contain n 1's, n 2's, . . . , n p's, the total sum of the squared deviations from the grand mean is the same no matter what the arrangement of the ranks within the table—it is, in fact, equal to $np(p^2-1)/12$. The sum of squares within columns plus the sum of squares between columns must add up to this total. Knowledge of one of these sums of squares thus implies knowledge of the other. In the above example we have used the sum of squares between columns; no additional information is thus supplied by the sum of squares within columns.

It should be noted that in testing the significance of the differences among the columns no assumption whatsoever needs to be made as to the similarity of the distribution of the original variate for the different rows. The test takes the form of comparing the mean ranks for the several columns; essentially, however, the null hypothesis tested is

[10a] See Hotelling and Pabst, *op. cit.*, pp. 35 and 40, and Fisher, *op. cit.* art., 21.1.

that the original entries in each row are from the same universe; whether or not this universe is the same for the different rows is entirely irrelevant to the validity of the test.

The method of ranks does not provide for testing "interaction." It is of the very nature of the method that it cannot do so. Without exact quantitative measurement, "interaction," in the sense used in the ordinary analysis of variance, is meaningless.

It should further be noted that the method of ranks may not provide a test of the influence of a factor if there is reason to suspect that this influence is in a different *direction* for the different rows; if, for example, the standard deviation increases with income for certain types of expenditure and decreases with income for others. For in such a case the mean ranks of the p columns may all have the same expected value, although the p ranks for each of the rows do not. Thus, if χ_r^2 is significant, the conclusion is that the ranking is not random. But χ_r^2 may not be significant, not because the ranking is random, or because the differences in the mean ranks are too small for the observed sample to display significance, but because the influence of the factor tested is different in direction for the different rows. In this connection, however the general point should be emphasized that non-significant results do not establish the validity of the null hypothesis in the same way that significant results tend to contradict it.

In some cases two (or more) of the values of the variate in a row will be identical, i.e., there will be "tied" ranks. Two procedures can be followed: first, the ranks tied for can be assigned to the two (or more) values at random; or second, each value can be given the average value of the ranks tied for (e.g., if two values are tied for the ranks 2 and 3 each can be given the rank of 2.5). In general, the second of these procedures seems to be preferable, since it uses slightly more of the information provided by the data.[11] The substitution of the average rank for the tied values does not affect the validity of the χ_r^2 test.[12]

THE EFFICIENCY OF THE METHOD OF RANKS RELATIVE TO THE ANALYSIS OF VARIANCE

It is evident that the method of ranks does not utilize all of the information furnished by the data, since it relies solely on order and

[11] This alternative method of handling tied ranks and its advantages were brought to my attention by Mr. W. Allen Wallis, who has developed a simple adjustment to the usual formula for the rank-difference correlation to allow for the treatment of tied ranks in this fashion.

[12] Its only effect is to change very slightly the "true" value of the variance. In the extreme case when tied ranks are as probable as untied ranks, the variance of an individual observation is changed from $(p^3-1)/12$ to $p(p-1)/12$, i.e., it is reduced by $(p-1)/12$ or in the ratio of 1 to $p+1$. The reduction is thus relatively small when p is moderately large.

makes no use of the quantitative magnitude of the variate. It is this very fact that makes it independent of the assumption of normality. At the same time, it is desirable to obtain some notion about the amount of information lost, that is, about the efficiency of the method of ranks in situations where the analysis of variance provides the proper test.[13]

For the special case of $p=2$ (i.e., of two ranks) the method of ranks is equivalent to the binomial series test of significance of a mean difference, that is, it is equivalent to testing whether the proportion of positive differences between the pairs of values in each row of the $2\times n$ table (the proportion of 2's in the first column of the table of ranks) differs significantly from $\frac{1}{2}$.[14] Now, W. G. Cochran recently showed[15] that the binomial series test of a mean difference has an efficiency of 63.7 per cent. It follows that the method of ranks, for the special case of $p=2$, likewise has an efficiency of 63.7 per cent.

[13] By the "efficiency" of a statistic m used to estimate a parameter μ is meant the ratio of the variance of the maximum likelihood estimate of μ to the variance of m. The difference between this ratio and unity multiplied by 100 gives the percentage of "information" lost. (R. A. Fisher, *op. cit.*, Chapter IX.)

In the present instance, since the analysis of ranks and the analysis of variance provide estimates of different parameters—in the one case, of χ_r^2, and in the other, of the analysis of variance ratio—it is first necessary to secure a relationship between the two parameters which can be used to estimate one from the other. In this way both methods can be used to estimate the same parameter.

[14] The analogous method for p greater than 2, while it provides a method for analysing a table of ranks and seems superficially closely related to the method of ranks, is essentially very different.

This alternative procedure involves the formation from the basic table of ranks of a $p\times p$ contingency table giving the number of ranks of each size in each column. Thus, one of the classifications is by column number, the other by the value of the rank. Such tables can then be analyzed by computing χ^2 in the usual manner and testing its significance. Unless the number of rows is large *relative to the number of columns*, the usual χ^2 tables will, of course, not be applicable. Exact distributions can, however, be obtained in the manner indicated by F. Yates ("Contingency Tables Involving Small Numbers and the χ^2 Test," *Journal of the Royal Statistical Society*, Supplement, Volume I (1934), pp. 217–35).

This procedure does not, however, test the same hypothesis as the method of ranks. The reason is that with the contingency table method the numerical values of the ranks in no way affect the result, whereas in the method of ranks they do. Thus, consider the following 3×3 tables of ranks:

A.				B.			
	1	2	3		1	2	3
	1	2	3		1	2	3
	3	2	1		1	3	2

It is clear that B indicates greater departure from the hypothesis that the ranking is random than does A. Both tables contain one column in which all three ranks are identical and two columns in which two out of three ranks are the same. But in B these latter two columns contain ranks which vary less than for the corresponding columns of A. Stated differently, in B *every* rank in the last two columns is greater than *any* rank in the first; no comparable statement is valid for A.

The contingency analysis would indicate, however, that A and B diverge equally from expectation, since both will give contingency tables which, except for permutations of rows and columns, are identical. The method of ranks, on the other hand, will indicate that B diverges more from expectation than A; χ_r^2 is 4$\frac{1}{2}$ for B, but only $\frac{1}{2}$ for A.

For the purpose of determining whether one variable has a significant influence on another, it seems clear that the method of ranks is definitely preferable to the contingency analysis just outlined.

The reason why the two methods are equivalent for $p=2$ is evident; when there are only two ranks, there is no possibility of different ranks diverging by varying amounts.

[15] "The Efficiencies of the Binomial Series Tests of Significance of a Mean and of a Correlation Coefficient," *Journal of the Royal Statistical Society*, C (1937), 69–73.

Moreover, this provides a measure of the *minimum* efficiency of the method of ranks. When $p=2$, a classification in terms solely of greater or smaller is substituted for the exact quantitative measurements; as p increases a more and more finely subdivided scale is substituted for the exact measurements. It seems reasonable, therefore, that the loss in information through using ranks decreases as p increases.

For the special case of $n=2$, it is shown below that χ_r^2 and the rank difference correlation are essentially equivalent. On the assumption that the true correlation is zero, Hotelling and Pabst have shown that the efficiency of the rank difference correlation approaches 91.19 per cent as p increases. In their words, "the product-moment correlation is approximately as sensitive a test of the existence of a relationship in a normally distributed population with 91 cases as the rank correlation with 100 cases."[16]

For the more general case, when p and n are greater than 2 I have not been able to determine the efficiency of the method of ranks. It seems clear, however, that the loss of information is less than the 36 per cent lost when $p=2$ and probably greater than the 9 per cent lost when $n=2$.

In the absence of the theoretical analysis there are presented here the results of applying both the analysis of variance and the method of ranks to the same data. A comparison of these results will, of course, offer no conclusive evidence as to the relative efficiency of the two methods; but it should at least suggest whether the loss of information in using the method of ranks is so great as to vitiate completely its usefulness.

The data analyzed are the same as those utilized in the illustrative analysis summarized in Tables I and II above, i.e., they are data on the expenditures and savings during 1935–36 of 246 Minneapolis and St. Paul families of wage earners and lower salaried clerical workers. In the present instance, however, the analysis is directed toward determining whether income and family composition have a significant influence on the expenditures for the various categories and on savings. The analysis given above, it will be recalled, attempted to determine whether income had a significant influence on the *standard deviations* of expenditure.

The 246 families have been grouped into seven income classes,[17]

[16] *Op. cit.*, pp. 42–43.

[17] The total income of a family is defined as including not only money income, but also the imputed value of gifts in kind, of food produced at home and of the use of a home owned by the family.

each $250 in range, and five family composition types.[18] This gives 35 groups in all.

For each of the major categories of expenditures, for savings, and for certain sub-groups of items, three variances have been computed: the variance (1) between income levels, (2) between family types, and (3) within groups.[19]

For 14 major categories of expenditure, for 13 sub-groups of several of these categories, and for savings, there was computed the ratios of the variance between income levels and the variance between family types to the variance within groups. These ratios, designated as F_i and F_f respectively, are given in Table III.

To each of the 28 items considered, the method of ranks was also applied to test the influence of income and family type.

In testing the influence of income, the seven mean expenditures for each family type were ranked. This gave five sets of seven ranks. In testing the influence of family type the procedure was reversed; the five mean expenditures at each income level were ranked, giving seven sets of five ranks.

The results of the method of ranks are likewise given in Table III. This table gives the values of χ_r^2 computed in testing for the influence of income, as well as those obtained in testing for the influence of family type.

For both the analysis of variance and the method of ranks the values which are significant at the .01 level are indicated with a double star; those which are significant only at the .05 level, with a single star.

The two methods yield measures of the influence of income and family type for 28 items. There are thus 56 independent analyses by each method. In Table III these measures are classified into three

[18] The family types are defined as follows:

Type 1 Husband, wife, and one child under 16
2 Husband, wife, and two children under 16
3 Husband, wife, one person 16 or over, and one or no other persons
4 Husband, wife, one child under 16, one person 16 or over, and one or two other persons
5 Husband, wife, and three or four children under 16.

[19] There was also computed the variance due to interaction. Since the method of ranks can give no measure of interaction, this variance is of no interest here. It is worth pointing out, however, that interaction was significant for only three out of 28 cases; for one of those the probability was between .05 and .01 and for two it was less than .01.

Since the numbers of items in the subclasses are neither equal nor proportionate, there is some difficulty in decomposing the variation between groups. The variances between income levels and between family types were computed by the method of weighted squares of means. This method does not give an estimate of interaction when there are more than two classes for both of the factors. Consequently, the variance due to interaction was computed by the method of unweighted means.

For an excellent statement of the difficulties raised by disproportionate subclass numbers and of the available methods of analysis, see G. C. Snedecor, and G. M. Cox, "Disproportionate Subclass Numbers in Tables of Multiple Classification," Research Bulletin 180, Agricultural Experiment Station, Iowa State College of Agriculture and Mechanic Arts (March 1935).

TABLE III

RESULTS OF ANALYSIS OF VARIANCE AND METHOD OF RANKS

Measures of the Influence of Income and Family Type on Expenditures for the Major Categories of Expenditure and for Sub-Groups of Items, and on Savings, Based on Data on the Expenditures and Savings During 1935–36 of 246 Minneapolis and St. Paul Families[1]

Item	Analysis of variance Ratios of variances[2]		Method of ranks χ_r^2	
	Income F_i	Family type F_f	Income	Family type
Major categories of expenditure[3]				
Food	15.33**	5.75**	27.02**	19.09**
Household operation	9.95**	1.01	24.24**	4.94
Housing	9.50**	1.63	21.94**	6.17
Clothing	9.40**	1.38	25.54**	9.46
Recreation	4.25**	1.98	23.83**	11.89*
Personal care	4.10**	.80	21.11**	4.14
Transportation	3.78**	1.97	24.00**	10.06*
Gifts	3.36**	.96	21.17**	3.74
Community welfare	2.95**	.45	17.04**	.49
Education	2.93**	1.79	17.31**	8.11
Medical care	2.51*	.80	18.69**	6.51
Vocation	.69	1.01	4.71	1.51
Furnishings and equipment	.42	.37	6.96	3.69
Other	.25	.30	5.74	5.40
Savings (or deficit)	2.50*	1.25	14.74*	4.57
Sub-groups of items				
Food[4]:				
Dairy products	6.71**	9.41**	23.66**	21.83**
Fruit	4.87**	.38	12.69*	3.31
Food away from home	3.49**	3.94**	17.34**	10.09*
Meat	2.59*	2.02	9.34	3.77
Miscellaneous foods	2.01	1.21	15.00*	5.49
Fish	.98	2.43*	4.11	1.91
Vegetables	.73	2.11	6.69	8.80
Grain products	.71	4.76**	3.26	9.71*
Sweets	.20	1.05	3.96	9.94*
Poultry	.20	.99	.30	1.89
Personal care:				
Personal service	4.31**	.70	19.80**	4.71
Personal supplies	3.38**	.75	14.34*	1.49
Household operation:				
Fuel and light[5]	7.26**	1.56	23.25**	6.74

* Indicates that observed figure is "significant," i.e., greater than the value which would be exceeded by chance once in twenty times. For the ratios of variances this value is 2.14 for income and 2.42 for family type. For χ_r^2 it is 12.592 for income and 9.488 for family type. The difference between the values for income and family type is a result of a difference in the number of degrees of freedom on which the respective estimates are based.

** Indicates that observed figure is "highly significant," i.e., greater than the value which would be exceeded but once in a hundred times by chance. For the ratios of variances this value is 2.89 for income and 3.41 for family type. For χ_r^2 it is 15.033 for income and 13.277 for family type.

[1] The figures in this table are based on schedules collected by the Cost of Living Division of the U. S. Bureau of Labor Statistics. These schedules were loaned to the National Resources Committee for special analyses, one of which is presented here.

[2, 3, 4, 5] See next page.

groups: those which would have been exceeded by chance (a) in more than five per cent of random samples, (b) in between five per cent and one per cent of random samples, and (c) in less than one per cent of random samples. An indication of the relative efficiency of the two methods is provided by Table IV, which gives a comparison of the two classifications.

From the entries in the diagonal of Table IV, it is seen that for 45 out of the 56 analyses the two methods lead to similar conclusions. In no case does one of the methods indicate a probability of less than .01 while the other indicates a probability greater than .05.

TABLE IV

COMPARISON OF RESULTS OF ANALYSIS OF VARIANCE AND METHOD OF RANKS

Method of ranks Probability of χ_r^2	Analysis of variance Number of F's with probability			Total
	Greater than .05	Between .05 and .01	Less than .01	
Greater than .05	28	2	0	30
Between .05 and .01	4	1	4	9
Less than .01	0	1	16	17
Total	32	4	20	56

In this example, it seems clear that the loss of information in using the method of ranks is not very great. Indeed, on the basis of Table IV alone, it would be difficult, if not impossible, to choose between the two methods.

A comparison of the ranking of the 28 items by the size of F and by the size of χ_r^2, provides one further indication that the hypotheses tested by the two methods are essentially the same except for the inclusion of the normality assumption in that tested by the analysis of variance. The rank difference correlation between F_i and the corresponding χ_r^2 is .88; between F_f and the corresponding χ_r^2, .66. Both correlations are very large in comparison with their standard error of .19.

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[2] F_i is the ratio of the variance between income levels to the variance within classes. F_f is the ratio of the variance between family types to the variance within classes.

[3] Expenditures include not only money expenses but also the imputed value of gifts in kind. For food, the imputed value of home produced food, and for housing, the imputed value of the use of an owned home, are also included.

[4] The original data give the expenditures on the sub-groups of food only for a seven day period. The remaining ratios in the table are all based on data for annual expenditures.

[5] Fuel and light is, of course, but one of the sub-groups under household operation.

It should be noted that the illustrative comparison just presented is to some extent weighted against the analysis of variance. The distribution of expenditure data departs considerably from normality.[20] In addition, the analysis summarized in Tables I and II indicated that the standard deviation of expenditures is related to the income level; the assumption of uniform variance is, therefore, not justified. However, the body of data analyzed represents no more extreme a departure from the assumptions of normality and uniform variance than is frequently met with.

THE RELATION BETWEEN THE DISTRIBUTION OF χ_r^2 AND χ^2

The statement was made above without proof that χ_r^2 tends to be distributed as χ^2 with $p-1$ degrees of freedom. This statement requires justification.

It is well known that the sum of the squares of m independent observations drawn from a normal universe with unit variance and zero mean is distributed according to the χ^2 distribution with m degrees of freedom. In the present instance, when the number of rows is not too small, the mean ranks can be treated as observations from a normal universe with a true mean $\frac{1}{2}(p+1)$. However, only $p-1$ of the p mean ranks are independent, since the sum of the p mean ranks must equal $\frac{1}{2}p(p+1)$. If $(p-1)$ of them were selected at random, the sum of the squared deviations from the true mean of $\frac{1}{2}(p+1)$ would seem to be distributed as χ^2. However, to discard one of the mean ranks would neglect some of the information; in addition, there is no criterion for deciding which to discard. Instead we can compute the mean squared deviation and multiply it by the number of degrees of freedom, $(p-1)$. This gives[21]

$$\frac{p-1}{p}\sum_{j=1}^{p}(\bar{r}_j-\rho)^2$$

as the numerator of χ_r^2. The denominator must be σ^2, the variance of $\bar{r}$.

[20] On the question of the effect of departure from normality on the analysis of variance, see Egon S. Pearson, "The Analysis of Variance in Cases of Non-normal Variation," *Biometrika*, Vol. 23, 1931, and T. Eden and F. Yates, "On the Validity of Fisher's z Test When Applied to an Actual Example of Non-Normal Data," *Journal of Agricultural Science*, Vol. 23, 1933. The conclusion of both papers is that moderate departure from normality does not seriously affect the analysis of variance.

[21] By analogy with χ^2 as ordinarily defined, the multiplier $(p-1)/p$ seems unnecessary. The difference is this. In the ordinary case we have a sum of squares *artificially lessened* because the deviations are computed from the observed *rather than* the true mean. Here, the observed mean is, of necessity, equal to the true mean. We thus have the sum of p squared deviations from the *true* mean, one of these, however, being essentially a duplication. This is evident when there are only two columns and the two deviations must be equal in absolute value; it is less obvious when there are more than two columns and the duplication is, as it were, spread among all of the deviations. A rigorous demonstration that $(p-1)/p$ is the multiplier needed to correct for this duplication is provided by the proof in the mathematical appendix that the χ_r^2 distribution approaches that of χ^2.

This statement, of course, is not a rigorous proof that the distribution of χ_r^2 approaches the distribution of χ^2 as n increases. A rigorous proof has, however, been provided by Dr. S. S. Wilks and is reproduced in the mathematical appendix.

In addition, the exact values of the first three moments of χ_r^2 have been derived.[22] The mean value is $p-1$; the variance, $2(p-1)(n-1)/n$; and the third moment about the mean, $8(p-1)(n-1)(n-2)/n^2$. The

TABLE V

EXACT DISTRIBUTION OF χ_r^2 FOR TABLES WITH FROM 2 TO 9 SETS OF THREE RANKS

($p=3$; $n=2, 3, 4, 5, 6, 7, 8, 9$)

P is the probability of obtaining a value of χ_r^2 as great as or greater than the corresponding value of χ_r^2

$n=2$		$n=5$		$n=7$		$n=8$		$n=9$	
χ_r^2	P	χ_r^2	P	χ_r^2	P	χ_r^2	P	χ_r^2	P
0	1.000	0.0	1.000	0.000	1.000	0.00	1.000	0.000	1.000
1	.833	0.4	.954	0.286	.964	0.25	.967	0.222	.971
3	.500	1.2	.691	0.857	.768	0.75	.794	0.667	.814
4	.167	1.6	.522	1.143	.620	1.00	.654	0.889	.865
$n=3$		2.8	.367	2.000	.486	1.75	.531	1.556	.569
χ_r^2	P	3.6	.182	2.571	.305	2.25	.355	2.000	.398
0.000	1.000	4.8	.124	3.429	.237	3.00	.285	2.667	.328
0.667	.944	5.2	.093	3.714	.192	3.25	.236	2.889	.278
2.000	.528	6.4	.039	4.571	.112	4.00	.149	3.556	.187
2.667	.361	7.6	.024	5.429	.085	4.75	.120	4.222	.154
4.667	.194	8.4	.0085	6.000	.052	5.25	.079	4.667	.107
6.000	.028	10.0	.00077	7.143	.027	6.25	.047	5.556	.069
$n=4$		$n=6$		7.714	.021	6.75	.038	6.000	.057
χ_r^2	P	χ_r^2	P	8.000	.016	7.00	.030	6.222	.048
0.0	1.000	0.00	1.000	8.857	.0084	7.75	.018	6.889	.031
0.5	.931	0.33	.956	10.286	.0036	9.00	.0099	8.000	.019
1.5	.653	1.00	.740	10.571	.0027	9.25	.0080	8.222	.016
2.0	.431	1.33	.570	11.143	.0012	9.75	.0048	8.667	.010
3.5	.273	2.33	.430	12.286	.00032	10.75	.0024	9.556	.0060
4.5	.125	3.00	.252	14.000	.000021	12.00	.0011	10.667	.0035
6.0	.069	4.00	.184			12.25	.00086	10.889	.0029
6.5	.042	4.33	.142			13.00	.00026	11.556	.0013
8.0	.0046	5.33	.072			14.25	.000061	12.667	.00066
		6.33	.052			16.00	.0000036	13.556	.00035
		7.00	.029					14.000	.00020
		8.33	.012					14.222	.000097
		9.00	.0081					14.889	.000054
		9.33	.0055					16.222	.000011
		10.33	.0017					18.000	.0000006
		12.00	.00013						

corresponding values for the χ^2 distribution with $p-1$ degrees of freedom are $p-1$, $2(p-1)$, and $8(p-1)$, respectively. It follows that χ_r^2 and χ^2 always have the same mean value, and that the variance and

[22] I am indebted to Mr. William C. Shelton for the derivation of the mean value and for suggesting the method of deriving the other moments.

third moment of χ_r^2 approach the variance and third moment of χ^2 as n increases.

For the special case of $p=3$, the exact distribution of χ_r^2 has been derived for n from 2 to 9; and for $p=4$, for n equal to 2, 3 and 4.[23] Table V gives the distributions for $p=3$, and Table VI for $p=4$. These distributions give some empirical indication of how rapidly the χ_r^2 distribution approaches the χ^2 distribution; in addition, they can be used to make exact tests for small values of n and p.

TABLE VI

EXACT DISTRIBUTION OF χ_r^2 FOR TABLES WITH FROM 2 TO 4 SETS OF FOUR RANKS

($p=4$; $n=2, 3, 4$)

P is the probability of obtaining a value of χ_r^2 as great as or greater than the corresponding value of χ_r^2.

$n=2$		$n=3$		$n=4$			
χ_r^2	P	χ_r^2	P	χ_r^2	P	χ_r^2	P
0.0	1.000	0.2	1.000	0.0	1.000	5.7	.141
0.6	.958	0.6	.958	0.3	.992	6.0	.105
1.2	.834	1.0	.910	0.6	.928	6.3	.094
1.8	.792	1.8	.727	0.9	.900	6.6	.077
2.4	.625	2.2	.608	1.2	.800	6.9	.068
3.0	.542	2.6	.524	1.5	.754	7.2	.054
3.6	.458	3.4	.446	1.8	.677	7.5	.052
4.2	.375	3.8	.342	2.1	.649	7.8	.036
4.8	.208	4.2	.300	2.4	.524	8.1	.033
5.4	.167	5.0	.207	2.7	.508	8.4	.019
6.0	.042	5.4	.175	3.0	.432	8.7	.014
		5.8	.148	3.3	.389	9.3	.012
		6.6	.075	3.6	.355	9.6	.0069
		7.0	.054	3.9	.324	9.9	.0062
		7.4	.033	4.5	.242	10.2	.0027
		8.2	.017	4.8	.200	10.8	.0016
		9.0	.0017	5.1	.190	11.1	.00034
				5.4	.158	12.0	.000072

The tables show that if we adopt .01 as a level of significance, then for $p=3$, it is impossible to obtain a significant value for n less than 4, and for $n=4$ only perfect consistency will yield a significant value; for $n=5$, two values will satisfy the criterion and for $n=6$, four values. If .05 is adopted as a level of significance, only perfect consistency is significant for $n=3$, while 2 values are significant for $n=4$, and four values for $n=5$.

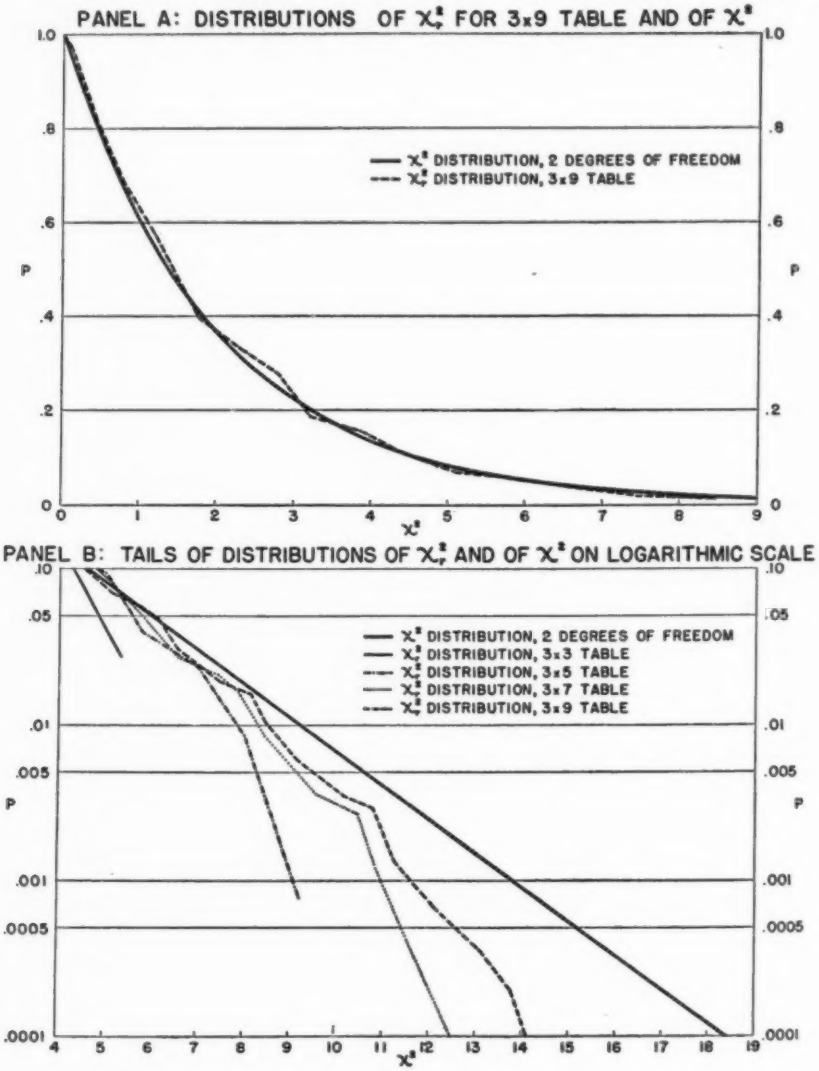
For $p=4$, the .01 criterion cannot be satisfied for $n=2$, is satisfied by perfect consistency for $n=3$, and by 6 values for $n=4$. The .05

[23] These distributions were derived by the rather laborious process of building up the distribution for each value of n from the distribution for the next smaller value. The labor involved increases greatly as n increases, and even more rapidly as p increases.

criterion is satisfied by one value for $n=2$, three values for $n=3$, and 11 values for $n=4$.

CHART 1

COMPARISON OF DISTRIBUTIONS OF χ_r^2 AND χ^2 FOR TWO DEGREES OF FREEDOM


PANEL A: DISTRIBUTIONS OF χ_r^2 FOR 3x9 TABLE AND OF χ^2
χ^2 DISTRIBUTION, 2 DEGREES OF FREEDOM
χ_r^2 DISTRIBUTION, 3x9 TABLE
P
χ^2
PANEL B: TAILS OF DISTRIBUTIONS OF χ_r^2 AND OF χ^2 ON LOGARITHMIC SCALE
χ^2 DISTRIBUTION, 2 DEGREES OF FREEDOM
χ_r^2 DISTRIBUTION, 3x3 TABLE
χ_r^2 DISTRIBUTION, 3x5 TABLE
χ_r^2 DISTRIBUTION, 3x7 TABLE
χ_r^2 DISTRIBUTION, 3x9 TABLE
P
χ^2

The comparison of the χ_r^2 distribution with the χ^2 distribution is shown in Chart 1 for $p=3$ and in Chart 2 for $p=4$. In making this com-

parison it is necessary to allow for the discontinuity of the χ_r^2 distribution. Only a discrete number of finite values of χ_r^2 are possible while χ^2 is continuous. The probability associated with any χ_r^2 in Tables V and VI must thus be considered as corresponding to a value of χ^2 intermediate between that value of χ_r^2 and the immediately preceding value. This intermediate value has been arbitrarily chosen as halfway between the two values of χ_r^2. It is these intermediate values which form the abscissas of the points plotted in the charts.

Panel A of Chart 1 compares the χ_r^2 distribution for a 3×9 table with the χ^2 distribution for 2 degrees of freedom. For convenience, the distributions have been compared in cumulative form. The ordinate gives the probability of securing a value of χ^2 or χ_r^2 as great as or greater than the abscissa. The solid line gives the χ^2 distribution, the dotted line, the χ_r^2 distribution. The agreement between the two distributions is very close. The cumulative curve for the χ_r^2 distribution tends to be somewhat above that for the χ^2 distribution for low values of χ_r^2 and below it for high values. This is to be expected since χ_r^2 must be less than a fixed finite value (that corresponding to perfect consistency) while χ^2 is not so limited.

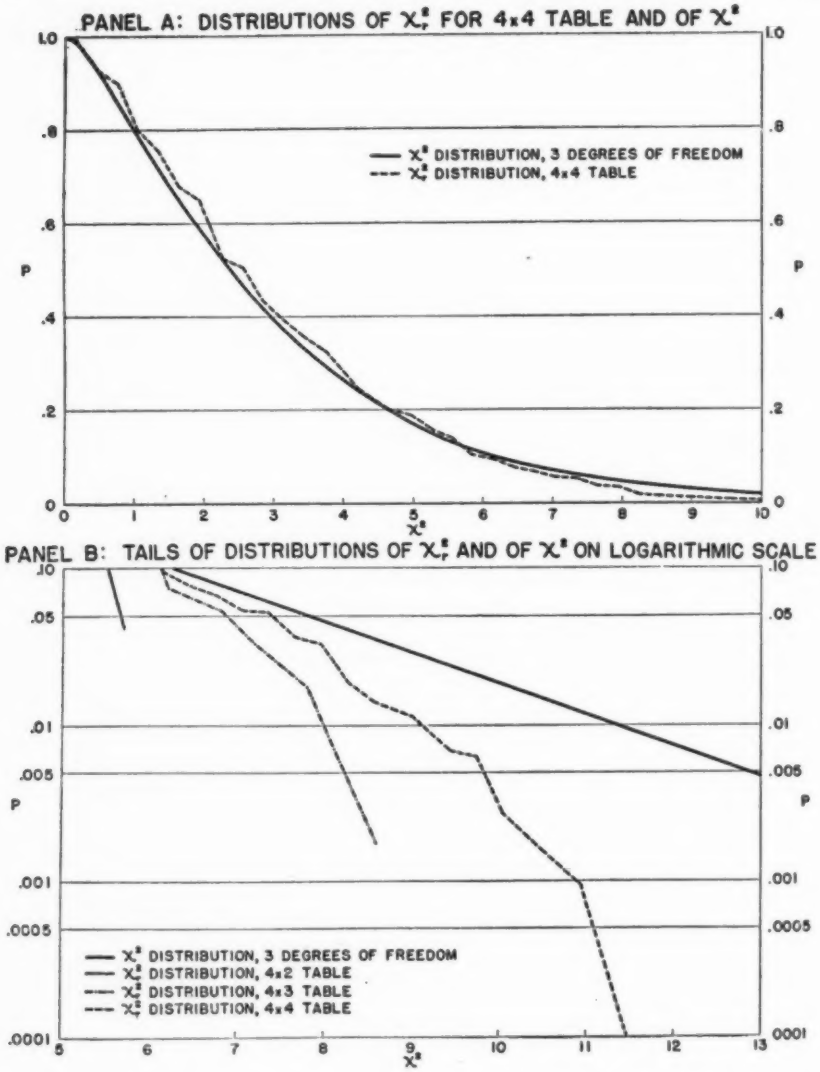
In utilizing tests of significance, it is the small values of P, i.e., one of the tails of the distribution, with which we are ordinarily concerned. In order to bring out more clearly the behavior of this part of the χ_r^2 distribution, a logarithmic scale is used for the probability in Panel B of Chart 1. This panel gives the cumulative distribution of χ_r^2 to the right of $P=.10$ for $p=3$, and $n=3, 5, 7, 9$; as well as the corresponding portion of the χ^2 distribution. The chart shows the tendency of this portion of the χ_r^2 curve to be below the χ^2 curve. It also clearly indicates the tendency for the χ_r^2 distribution to approach the χ^2 distribution and suggests that it does so fairly rapidly.

Panels A and B of Chart 2 are similar to the corresponding panels of Chart 1, but relate to $p=4$. Panel A compares the χ_r^2 distribution for a 4×4 table with the χ^2 distribution for three degrees of freedom. The agreement is good, although, because of the smaller value of n, the discrepancies are somewhat greater than in Panel A of Chart 1. It indicates the same consistent tendency for the χ_r^2 distribution to be above the χ^2 distribution for small values of χ_r^2 and below it for large values. Panel B gives the portion of the cumulative distribution of χ_r^2 to the right of $p=.10$, for $p=4$ and $n=2, 3, 4$, as well as the corresponding portion of the χ^2 distribution. Once again the vertical scale is logarithmic. The tendency for the χ_r^2 distribution to approach the χ^2 distribution very rapidly as n increases, is plain.

The tendency for the values of χ_r^2 adjusted for discontinuity to be less than χ^2 for small probabilities suggests that any errors resulting

CHART 2

COMPARISON OF DISTRIBUTIONS OF χ_r^2 AND χ^2 FOR THREE DEGREES OF FREEDOM


PANEL A: DISTRIBUTIONS OF χ_r^2 FOR 4x4 TABLE AND OF χ^2
χ^2 DISTRIBUTION, 3 DEGREES OF FREEDOM
χ_r^2 DISTRIBUTION, 4x4 TABLE
P
χ^2
PANEL B: TAILS OF DISTRIBUTIONS OF χ_r^2 AND OF χ^2 ON LOGARITHMIC SCALE
χ^2 DISTRIBUTION, 3 DEGREES OF FREEDOM
χ_r^2 DISTRIBUTION, 4x2 TABLE
χ_r^2 DISTRIBUTION, 4x3 TABLE
χ_r^2 DISTRIBUTION, 4x4 TABLE
P
χ^2

from using the χ^2 distribution as an approximation to the χ_r^2 distribution are likely to be in the proper direction—that is, the significance of

results will be understated rather than exaggerated. This tendency toward under-statement is compensated—indeed, in some cases over-compensated—by the fact that the values of χ_r^2 which can be observed (i.e., the values of χ_r^2 not adjusted for discontinuity) are always greater than the adjusted values. This factor is of minor significance, however, since the number of possible values of χ_r^2 increases very rapidly—and hence the interval between them decreases very rapidly—as either p or n increases. Even for p and n both as small as 4, the difference between the adjusted and unadjusted values of χ_r^2 is, for practical purposes, negligible. It is .15 in all but four cases, .3 in three of these, and 45 in the remaining one.

A comparison of the χ^2 and χ_r^2 distributions at the critical points sheds further light on this problem. For $p=3$ the value of χ^2 corresponding to $P=.05$ is 5.991. From Table V, the nearest value which χ_r^2 can have for $p=3$, $n=9$ is 6, and this has a probability of .057 associated with it. Thus, by using the χ^2 distribution we should be led to overestimate slightly the significance of a value of $\chi_r^2=6$. The next higher value of χ_r^2 is 6.22, and its significance we should estimate properly, since the probability associated with it is .048. The value of χ^2 corresponding to $P=.01$ is 9.21. From Table V, the nearest values which χ_r^2 can have are 8.67, with a probability of .0103, and 9.55 with a probability of .0060. In this case, the use of the χ^2 distribution would yield the correct results; 8.66 would be attributed a probability greater than .01 and 9.55 one less than .01.

For $p=4$, the value of χ^2 corresponding to $P=.05$ is 7.815. The nearest values of χ_r^2 for $p=4$ and $n=4$, as given in Table VI, are 7.5 with a probability of .052, and 7.8 with a probability of .036. The .01 value of χ^2 is 11.341. From the table, 9.3 has a probability of .012, 9.6 of .0069, and 11.1 of .00094. Here, the use of χ^2 would in each case understate the significance of χ_r^2.

While no definitive conclusions can be drawn from these comparisons they suggest that for $p=3$, the use of the χ^2 distribution is likely to give sufficiently accurate results for n greater than 9; while for $p=4$, the use of the χ^2 distribution is likely to understate the significance of large values of χ_r^2 unless n is somewhat larger than 4. In view of the apparent rapidity with which the χ_r^2 distribution approaches the χ^2 distribution when $p=4$, it seems reasonable that for n equal to or greater than 6, the χ^2 distribution will give sufficiently accurate results. For p greater than 4 it is more difficult to make any general statement; but it seems safe to say that the χ^2 distribution will give fairly accurate

results for n equal to or greater than 6.[24] A procedure that seems applicable when p is quite large and n less than 6 is discussed below.

RELATION BETWEEN χ_r^2 AND THE RANK DIFFERENCE CORRELATION

When only two sets of ranks are available, the appropriate measure of relationship is the rank difference correlation coefficient, r'. This coefficient is computed by the usual product-moment formula with the ranks serving as the variables, or by the equivalent, but more convenient, formula

$$r' = 1 - \frac{6 \Sigma d^2}{p^3 - p},$$

where d is the difference between two paired values, and p, as above, is the number of pairs of ranks.[25]

For $n=2$, χ_r^2 uses the same data as the rank difference correlation and is designed to test the same hypothesis. The two are, therefore, essentially equivalent. It is shown in the mathematical appendix that the relation between them is

$$\chi_r^2 = (p - 1)(1 + r') .$$

For $n=2$ testing the significance of r' is thus equivalent to testing the significance of χ_r^2.

Under the hypothesis of homogeneity, the mean value of r' is zero, and its variance, $1/(p-1)$.[26] It follows from the last equation that, for $n=2$, both the mean value and variance of χ_r^2 are $(p-1)$. These results agree, of course, with the more general formulae given above.

THE APPROACH TO NORMALITY

Hotelling and Pabst have shown that r' tends to become normally distributed as p increases. It follows that for $n=2$, χ_r^2 tends also to become normally distributed as p increases.

When n is large the distribution of χ_r^2 approaches that of χ^2 and the latter approaches normality as the number of degrees of freedom increases.

Since, for the smallest value of n as well as for large values, the distribution of χ_r^2 tends to normality as p increases, it seems reasonable to assume that for intermediate values of n it behaves similarly. As-

[24] It is worth recalling that the rapidity with which the variance of the χ_r^2 distribution approaches the variance of the χ^2 distribution depends solely on n and not at all on p. On the other hand, the number of distinct values of χ_r^2 depends on both p and n.

[25] This is the usual notation except that the number of pairs of ranks is ordinarily designated as n. The present notation is used in order to preserve consistency with the preceding analysis.

[26] Hotelling and Pabst, *op. cit.*, p. 36.

suming this to be the case, then for small values of n and large values of p the significance of χ_r^2 can be tested by considering

$$\frac{\chi_r^2 - (p-1)}{2\frac{n-1}{n}(p-1)}$$

as a normally distributed variate with zero mean and unit standard deviation.

Further study is clearly needed on this point, both in order to obtain a rigorous proof that for small values of n the χ_r^2 distribution tends to normality as p increases, and also to determine the rapidity with which it approaches normality.

CONCLUSION

The method of ranks is a method which can be applied to data classified by two (or more) criteria to determine whether the factors used as criteria of classification have a significant influence on the variate classified. Stated differently, the method tests the hypothesis that the values of the variate corresponding to each subdivision by one of the factors are homogeneous, i.e., from the same universe. The method uses solely information on "order" and makes no use of the quantitative values of the variate as such. For this reason no assumption need be made as to the nature of the underlying universe or as to whether the different sets of values come from similar universes. The method is thus applicable to a wide class of problems to which the analysis of variance, designed to test a similar hypothesis, cannot validly be applied.

The basic step in the application of the method of ranks is the computation of a statistic, χ_r^2, from a table of ranks. The sampling distribution of this statistic approaches the χ^2 distribution as the number of sets of ranks increases. When the number of sets of ranks is moderately large (say greater than 5 for four or more ranks) the significance of χ_r^2 can be tested by reference to the available χ^2 tables. When the number of ranks in each set is 3, and the number of sets 9 or less, or when the number of ranks in each set is 4, and the number of sets 4 or less, the significance of χ_r^2 can be tested by reference to the exact tables given above. When, however, both the number of ranks and the number of sets of ranks are very small, it is impossible to obtain significant results.

When the number of ranks is large, but the number of sets of ranks small, there is reason to suppose—though no rigorous proof is avail-

able—that χ_r^2 is normally distributed about a mean of $p-1$ and with a variance of $2(p-1)\ (n-1)/n$, where p is the number of ranks and n the number of sets of ranks. In such cases, then, the significance of χ_r^2 can be tested by reference to tables of the normal curve.

The theoretical discussion of the efficiency of the method of ranks relative to the analysis of variance indicates that in situations when the latter method can validly be applied and when the number of sets of ranks is large the maximum loss of information through using the analysis of ranks is 36 per cent. The minimum loss is probably 9 per cent. The amount of information lost appears to be greatest when there are only two ranks in each set, and decreases as the number of ranks increases.

The application of the two methods to the same body of data provides further evidence as to their relative efficiency. The data employed were classified into five groups by one of the factors and into seven by the other. The results suggested that in this instance the loss of information through using the method of ranks was not very great, that both methods tended to yield the same result.

The method of ranks requires less than one-fourth as much time as the analysis of variance. In the light of the conclusions just stated concerning their relative efficiency, this suggests that even though the assumptions necessary for the latter method are known to be satisfied, if the problem of computation is a serious one, the method of ranks might profitably be used as an alternative to the analysis of variance or, at least, as a preliminary method to suggest fruitful hypotheses which might then be more accurately tested by the analysis of variance.

MATHEMATICAL APPENDIX

1. Proof that the χ_r^2 distribution approaches the χ^2 distribution as n *increases.*[27]

Let r_{ij}=the rank in the i-th row and j-th column, $(i=1, \cdots, n; j=1, \cdots, p)$

(1) $$r'_{ij} = r_{ij} - \tfrac{1}{2}(p+1)$$

and

(2) $$\bar{r}_j' = \frac{1}{n}\sum_{i=1}^{n} r'_{ij}\ .$$

The characteristic function of the quantities $\bar{r}_j'$ $(j=1, \cdots, p)$ is given by

(3) $$\phi = E\left(\exp i\sum_{j=1}^{p-1} \theta_j \bar{r}_j'\right)$$

[27] This proof is adapted from one given by Dr. S. S. Wilks in a letter to the author.

where E stands for expected value. Only $p-1$ of the $\bar{r}'_j$'s are included because $\bar{r}_p'$ is expressible in terms of $\bar{r}_1', \cdots, \bar{r}'_{p-1}$. This in turn follows from the fact that, for each value of i, r_{ij} takes all the values from 1 to p as j varies. Substituting from (2) into (3) we have

$$\phi = E\left(\exp \frac{i}{n} \sum_{i=1}^{n} \sum_{j=1}^{p-1} \theta_j r'_{ij}\right) . \tag{4}$$

Since the set of ranks in each row is independent of the set of ranks in any other row

$$\phi = \left[E\left(\exp \frac{i}{n} \sum_{j=1}^{p-1} \theta_j r_j'\right)\right]^n \tag{5}$$

where r_j' stands for any of the sets of r'_{ij}. Expanding,

$$\phi = \left\{E\left[1 + \frac{i}{n} \sum_{j=1}^{p-1} \theta_j r_j' + \frac{i^2}{2n^2}\left(\sum_{j=1}^{p-1} \theta_j r_j'\right)^2 + \frac{1}{n^3} R'\right]\right\}^n \tag{6}$$

or

$$\phi = \left\{E\left[1 + \frac{i}{n} \sum_{j=1}^{p-1} \theta_j r_j' + \frac{i^2}{2n^2}\left(\sum_{j=1}^{p-1} \theta_j^2 r_j'^2 + 2\sum_{j=1}^{p-2} \sum_{j'=j+1}^{p-1} \theta_j \theta_{j'} r_j' r'_{j'}\right) + \frac{1}{n^3} R'\right]\right\}^n . \tag{7}$$

But since r_j' takes all of the p values differing by unity from $-\frac{1}{2}(p-1)$ to $\frac{1}{2}(p-1)$ with equal probability

$$Er_j' = 0 , \tag{8}$$

$$Er_j'^2 = \frac{1}{p} \sum_{r_j'=-(p-1)/2}^{(p-1)/2} r_j'^2 = (p^2 - 1)/12 . \tag{9}$$

Further

$$Er_j' r'_{j'} = -(p+1)/12 \tag{10}$$

since

$$\left(\sum_{r_j'=-(p-1)/2}^{(p-1)/2} r_j'\right)^2 = \sum_{r_j'=-(p-1)/2}^{(p-1)/2} r_j'^2 + 2 \sum_{r_j'=-(p-1)/2}^{(p-3)/2} \sum_{r'_{j'}=r_j'+1}^{(p-1)/2} r_j' r'_{j'} = 0 \tag{11}$$

and hence

$$p(p-1)Er_j' r'_{j'} = -pEr_j'^2 = -p(p^2-1)/12 . \tag{12}$$

Using these results in (7) gives

$$\phi = \left\{1 - \frac{1}{2n^2}\left[\frac{p^2-1}{12}\sum_{j=1}^{p-1}\theta_j^2 - 2\frac{p+1}{12}\sum_{j=1}^{p-2}\sum_{j'=j+1}^{p-1}\theta_j\theta_{j'}\right] + \frac{1}{n^3}R\right\}^n \tag{13}$$

where R is a bounded function of $p, r_1', \cdots, r'_{p-1}$ for $n = 1, 2, 3, \cdots$.

Allowing n to approach infinity, we have

$$\phi \cong \exp -\frac{p^2-1}{24n}\left(\sum_{j=1}^{p-1}\theta_j^2 - \frac{2}{p-1}\sum_{j=1}^{p-2}\sum_{j'=j+1}^{p-1}\theta_j\theta_{j'}\right). \tag{14}$$

This, however, is the characteristic function for a multivariate normal distribution. It follows that $\bar{r}_1', \cdots, \bar{r}'_{p-1}$ are asymptotically normally distributed with a matrix of variances and covariances given by the matrix of the quadratic in $\theta_1, \cdots, \theta_{p-1}$

Taking the reciprocal of the matrix of the θ's and associating it with the $\bar{r}_j''$s we have as the distribution function of the $\bar{r}_j''$s:

$$C \exp\left\{-\frac{1}{2}\frac{12n}{p(p+1)}\left(2\sum_{j=1}^{p-1}\bar{r}_j'^2 + 2\sum_{j=1}^{p-2}\sum_{j'=j+1}^{p-1}\bar{r}_j'\bar{r}'_{j'}\right)\right\} d\bar{r}_1' d\bar{r}_2' \cdots d\bar{r}'_{p-1} \tag{15}$$

where C is a constant

Since $\sum_{j=1}^{p}\bar{r}_j' = 0$ it follows that $\bar{r}_p' = -\sum_{j=1}^{p-1}\bar{r}_j'$ and hence

$$\bar{r}_p'^2 = \left(\sum_{j=1}^{p-1}\bar{r}_j'\right)^2 = \sum_{j=1}^{p-1}\bar{r}_j'^2 + 2\sum_{j=1}^{p-2}\sum_{j'=j+1}^{p-1}\bar{r}_j'\bar{r}'_{j'}. \tag{16}$$

Substituting (16) in the exponent of (15) we have, finally, for the distribution function

$$C \exp\left\{-\frac{1}{2}\frac{12n}{p(p+1)}\sum_{j=1}^{p}\bar{r}_j'^2\right\} d\bar{r}_1' d\bar{r}_2' \cdots d\bar{r}'_{p-1} = C \exp\left(-\tfrac{1}{2}\chi_r^2\right) d\bar{r}_1' d\bar{r}_2' \cdots d\bar{r}'_{p-1}, \tag{17}$$

by the definition of χ_r^2. It follows that for n large χ_r^2 is distributed like χ^2 with $p-1$ degrees of freedom.

2. Derivation of the exact moments[28] *of* χ_r^2.

By definition

$$\chi_r^2 = \frac{12n}{p(p+1)}\sum_{j=1}^{p}\bar{r}_j'^2 = \frac{12n}{p(p+1)}\frac{1}{n^2}\sum_{j=1}^{p}\left(\sum_{i=1}^{n}r'_{ij}\right)^2. \tag{18}$$

[28] The derivation of the mean value of χ_r^2 is adapted from one communicated to the author by Mr. William C. Shelton, who also suggested the method used for deriving the other moments. The method employed is essentially that developed by J. Splawa-Neyman, "Contributions to the Theory of Small Samples Drawn from a Finite Population," *Biometrika*, Vol. 17, 1925, pages 472–79.

Expanding, replacing $\sum_{j=1}^{p}\sum_{i=1}^{n} r_{ij}^2$ by its value $np\ (p^2-1)/12$, and rearranging the order of the summation signs we have

$$\chi_r^2 = (p-1) + \frac{24}{p(p+1)n}\sum_{i=1}^{n-1}\sum_{i'=i+1}^{n}\sum_{j=1}^{p} r'_{ij}r'_{i'j} \,. \tag{19}$$

Taking the expected value of both sides gives

$$E\chi_r^2 = (p-1) + \frac{24}{p(p+1)n}\sum_{i=1}^{n-1}\sum_{i'=i+1}^{n}\sum_{j=1}^{p} E(r'_{ij}r'_{i'j}) \,. \tag{20}$$

But since one row of the table of ranks is entirely independent of any other row, $Er'_{ij}\,r'_{i'j}=Er'_{ij}\,Er'_{i'j}=0$.

$$\therefore \qquad E\chi_r^2 = p-1 \,. \tag{21}$$

From (19) and (21)

$$\chi_r^2 - E\chi_r^2 = \frac{24}{p(p+1)n}\sum_{i=1}^{n-1}\sum_{i'=i+1}^{n}\sum_{j=1}^{p} r'_{ij}r'_{i'j} \,. \tag{22}$$

The k-th moment of χ_r^2 about its mean value can therefore be obtained by evaluating the expected value of the k-th power of the right hand side of (22).

To determine the variance of χ_r^2 first note that $\sum_{j=1}^{p} r'_{ij}\,r'_{i'j}$ is independent of $\sum_{j=1}^{p} r'_{ij}\,r'_{i''j}$. This can be proved by multiplying the two expressions. The expected value of the resultant product is easily shown to be zero. Likewise, $\sum_{j=1}^{p} r''_{ij}\,r'_{i'j}$ is independent of $\sum_{j=1}^{p} r'_{i''j}\,r'_{i'''j}$. It follows that

$$E\left[\sum_{i=1}^{n-1}\sum_{i'=i+1}^{n}\sum_{j=1}^{p} r'_{ij}\ r'_{i'j}\right]^2 = \sum_{i=1}^{n-1}\sum_{i'=i+1}^{n} E\left(\sum_{j=1}^{p} r'_{ij}\,r'_{i'j}\right)^2. \tag{23}$$

But

$$\begin{aligned} E\left(\sum_{j=1}^{p} r'_{ij}r'_{i'j}\right)^2 &= E\left(\sum_{j=1}^{p} r'^2_{ij}r'^2_{i'j} + 2\sum_{j=1}^{p-1}\sum_{j'=j+1}^{p} r'_{ij}r'_{i'j}r'_{ij'}r'_{i'j'}\right) \\ &= \sum_{j=1}^{p} Er'^2_{ij}\,Er'^2_{i'j} + 2\sum_{j=1}^{p-1}\sum_{j'=j+1}^{p} E(r'_{ij}r'_{ij'})E(r'_{i'j}r'_{i'j'}) \,. \end{aligned} \tag{24}$$

Substituting (9) and (10) into (24) and the resultant expression into (23) gives

$$E\left[\sum_{i=1}^{n-1}\sum_{i'=i+1}^{n}\sum_{j=1}^{p} r'_{ij}\,r'_{i'j}\right]^2 = \frac{n(n-1)}{2}\,\frac{p^2(p-1)(p+1)^2}{12^2}. \tag{25}$$

Multiplying this by $[p(p+1)n/24]^{-2}$ gives, finally, the variance of χ_r^2

$$\sigma^2 = 2\,\frac{n-1}{n}\,(p-1). \tag{26}$$

To determine the third moment of χ_r^2 about its mean note that the only term in the expansion of

$$\left[\sum_{i=1}^{n-1}\sum_{i'=i+1}^{n}\sum_{j=1}^{p} r'_{ij}\,r'_{i'j}\right]^3$$

whose expected value is not zero is

$$6\sum_{i=1}^{n-2}\sum_{i'=i+1}^{n-1}\sum_{i''=i'+1}^{n}\left[\sum_{j=1}^{p} r'_{ij}\,r'_{i'j}\sum_{j=1}^{p} r'_{ij}\,r'_{i''j}\sum_{j=1}^{p} r'_{i'j}\,r'_{i''j}\right]. \tag{27}$$

Expanding the expression in brackets gives

$$\begin{aligned}\sum_{j=1}^{p} r'^{\,2}_{ij}\,r'^{\,2}_{i'j}\,r'^{\,2}_{i''j} &+ 3\sum_{j=1}^{p-1}\sum_{j'=j+1}^{p} r'^{\,2}_{ij}\,r'_{i'j}\,r'_{i''j}\,r'_{ij'}\,r'_{i'j'}\,r'_{i''j'} \\ &+ 6\sum_{j=1}^{p-2}\sum_{j'=j+1}^{p-1}\sum_{j''=j'+1}^{p} r'_{ij}\,r'_{i'j}\,r'_{ij'}\,r'_{i''j'}\,r'_{i'j''}\,r'_{i''j''}.\end{aligned} \tag{28}$$

Taking expected values, and substituting from (9) and (10) gives $p^3(p-1)(p+1)^3/12^3$ as the expected value of (28). Substituting this in (27) gives

$$E\left[\sum_{i=1}^{n-1}\sum_{i'=i+1}^{n}\sum_{j=1}^{p} r'_{ij}\,r'_{i'j}\right]^3 = \frac{6n(n-1)(n-2)}{1\cdot 2\cdot 3}\,\frac{p^3(p-1)(p+1)^3}{12^3}. \tag{29}$$

Multiplying this by $[p(p+1)n/24]^{-3}$ gives as the third moment of χ_r^2 about its mean

$$\mu_3 = \frac{8(n-1)(n-2)}{n^2}\,(p-1). \tag{30}$$

3. Derivation of relationship between χ_r^2 and rank difference correlation (r′) *when* n=*2.*

From (19) we have, for $n=2$

$$\chi_r^2 = (p-1) + \frac{12}{p(p+1)} \sum_{j=1}^{p} r'_{1j} r'_{2j} . \tag{31}$$

But, using the product moment formula, the rank difference correlation coefficient is defined as[29]

$$r' = \frac{\sum_{j=1}^{p} r'_{1j} r'_{2j}}{\sqrt{\sum_{j=1}^{p} r'^2_{1j} \sum_{j=1}^{p} r'^2_{2j}}} = \frac{12}{p(p^2-1)} \sum_{j=1}^{p} r'_{1j} r'_{2j} . \tag{32}$$

Substituting in (31) this gives

$$\chi_r^2 = (p-1)(1+r') \tag{33}$$

as the relation between χ_r^2 and the rank difference correlation coefficient.

[29] The notation used in (32) may be somewhat confusing. The symbol r' which stands for the rank difference correlation coefficient is to be distinguished from r'_{ij} which stands for the deviaton of a rank from its expected value.

SOME ADJUSTMENTS IN CENSUS DATA ON UNEMPLOYMENT

By Don D. Humphrey
Works Progress Administration

Studies of unemployment have usually been concerned with the number of workers unemployed. There are half a dozen current estimates of unemployment, such as those of the American Federation of Labor and the National Industrial Conference Board, all of which use the *worker* as the unit of measurement. The family, however, is a significant economic unit to consider in studies of unemployment. If a worker in a multi-worker family loses his job, the burden of support falls upon the other workers who may still be employed, but if the sole worker in a family becomes unemployed the family is deprived of all its earnings. From the relief standpoint, the number of families having no member employed is more significant than the number of workers unemployed. It makes a great difference, for example, whether the two million workers reemployed within the past year were workers from families, some of whose workers already were employed, or were workers from families which had no other members working.

In many unemployment censuses sufficient data have been gathered to determine the extent to which the unemployed workers fall in (a) partially unemployed families or (b) totally unemployed families, but with few exceptions the family data have not been tabulated. The clumsy expression "totally unemployed family" is used here, in the absence of anything better, to mean a family which has one or more workers all of whom are unemployed. "Partially unemployed family" is used to mean a multi-worker family which has one or more workers employed and one or more workers unemployed.

To interpret unemployment in terms of families requires some important adjustments in the census data. The relation between the two series—unemployed workers and families with no member employed—is not constant but varies with changes in unemployment. This functional relationship is also affected by geographical differences in the structure of family worker groups,[1] i.e., the percentage of one- and multi-worker families; consequently, adjustments in the raw data are requisite to interpretation and generalization. It is the character of this adjustment with which these comments are chiefly concerned.

[1] The expression "family worker group" refers to the *worker* or *group of workers* in a family, and, of course, is not the same thing as "size of family."

The empirical data[2] presented are partly from local censuses published in the *Monthly Labor Review* and partly from special tabulations made by the Works Progress Administration.

It is quite obvious that the specific rates of unemployment for family worker groups are characteristically different. Thus in Bridgeport, Connecticut, a census in 1934 showed that of the one-, two-, three-, and four-or-more-worker families, 21.8, 10.2, 6.4, and 4.5 per cent, respectively, were totally unemployed. Clearly the percentage of all family groups totally unemployed is nothing more than the weighted average of the specific rates for each group. Now this circumstance has an important result in regard to the use of the general rate to measure the functions relating the number of workers unemployed and the number of families totally unemployed. For suppose two communities to have identical specific rates for each family group, but suppose, also, as is the case, that one has twice as high a percentage of multi-worker families as the other. The city with the larger proportion of multi-worker families will, as a consequence, have a lower general rate for families totally unemployed. Because of the different distribution of family groups, communities are bound to have quite different general rates for families totally unemployed, even though, as postulated, the specific rates are identical.

The same problem in vital statistics is handled by the "standardized death-rate."[3] Due to different age distributions, two communities may have different crude death-rates, even though the specific rates for each age are identical. Consequently, crude death-rates are adjusted to allow for differences in the age distribution.

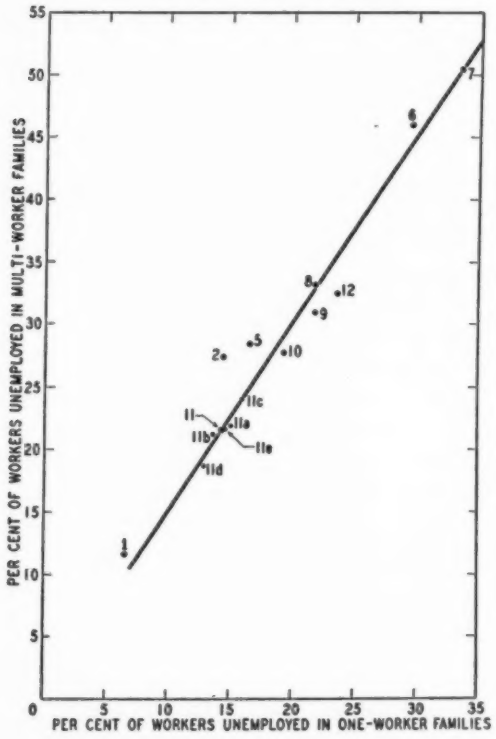
In the case of Bridgeport, the census showed 28 per cent of the workers unemployed and 15 per cent of the families totally unemployed. Only 52 per cent of Bridgeport's families were one-worker families in contrast to 64 per cent in urban United States. If the specific unemployment rates for each family worker group are weighted by the United States distribution, there are not 15.4 but 17.1 per cent of the families totally unemployed. This may be called the standardized rate, which is an abstract or theoretical figure, derived by reweighting the specific rates in a particular city according to the general urban distribution.

[2] The *Monthly Labor Review*, February 1930, May and June 1932, and May 1935, reports censuses for Philadelphia, Syracuse, Buffalo, and Bridgeport, respectively; a sample study of the policyholders of the Metropolitan Life Insurance Company was reported in the issue of March 1931. Special tabulations (unpublished) have been made of the Philadelphia censuses in 1931, 1932, 1933, and 1936, and of the Michigan census in 1935.

[3] Raymond Pearl, *Introduction to Medical Biometry and Statistics* (2d ed., 1930), ch. IX.

But the matter does not end here, for the corresponding rate of unemployment among workers must be similarly corrected. While it is an obvious fact that among families the specific rates will be characteristically different in one- and multi-worker families, it might be assumed that among workers the rate would be the same in all groups. But such is not the case. In all the studies examined, there is a marked

CHART I
RELATION BETWEEN WORKERS UNEMPLOYED IN ONE- AND IN MULTI-WORKER FAMILIES



difference in the rate of unemployment between workers in one- and in multi-worker families, the incidence of unemployment being heavily concentrated in the multi-worker groups. In Bridgeport, which is typical, workers in one- and multi-worker families were 21.8 and 30.8 per cent unemployed respectively. Thus, if the specific rates for workers in the one- and multi-worker families are weighted by the United States urban distribution, the standardized average rate of unemployment for all workers is 26.6 (crude rate 28.1).

It will be observed that, due to the different distribution of family worker groups, the family rate would need to be corrected even if workers in all family groups suffered unemployment at the same rate. The necessity for correcting the worker rate, however, arises solely from the fact that workers in one- and multi-worker families suffer unemployment at different rates.

The relation between workers unemployed in one- and multi-worker families is shown in Chart I and Table I. These data include the years from 1929 to 1936. The range of unemployment is from less than 10 to more than 40 per cent. The straight line has been fitted

TABLE I

PERCENTAGE OF WORKERS UNEMPLOYED IN ONE- AND MULTI-WORKER FAMILIES

Number in Chart I	Date	Location	Percentages	
			One-worker families	Multi-worker families
1	1929	Philadelphia	6.6	11.7
2	1930	Metro. Life Ins. Co.	14.5	27.3
*5	1931	Philadelphia	16.7	28.3(e)
6	1932	Philadelphia	29.7	45.9(e)
7	1933	Philadelphia	33.6	50.3
8	1934	Manhattan & Bronx	21.8	33.1(e)
9	1934	Bridgeport	21.8	30.8
10	1934	Dayton	19.4	27.7
11	1935	Michigan aggregate	14.4	21.5
11a		Cities, 40,00 and Over	15.1	21.8
11b		Cities, 3,000 to 40,000	13.7	21.2
11c		Towns and Villages	16.0	24.0
11d		Metropolitan Townships	12.9	18.7
11e		Rural Townships	14.7	21.6
12	1936	Philadelphia	23.7	32.4

(e) Partially estimated.

* Items 3 and 4 are omitted due to lack of detail.

free-hand and indicates that unemployment among workers in multi-worker families is 50 per cent higher than in one-worker families (within the range indicated).

The distribution of family worker groups shown in Table II indicates the basis for the adjustments. The relation between unemployed workers and families totally unemployed is shown in Table III and Chart II with both crude and standardized rates. Note that the horizontal scale in Charts II, III, and IV represents *all* workers. The curve has been fitted free-hand. It is clear from Chart II that the standardized data are more homogeneous, the differences due to the distribution of family groups having been eliminated.

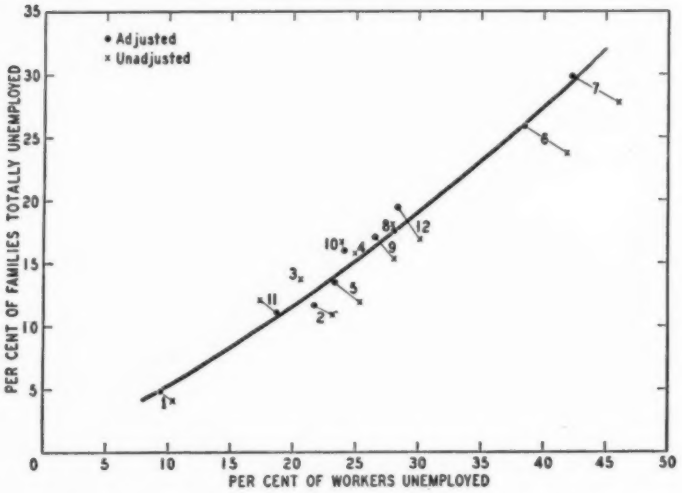
TABLE II

PERCENTAGE DISTRIBUTION OF FAMILY WORKER GROUPS FOR THE UNITED STATES AND SELECTED COMMUNITIES

	Date	All worker families	Families having			
			1 worker	2 workers	3 workers	4 or more workers
U. S. Census, Total	1930	100.0	66.1	22.5	7.6	3.8
Urban		100.0	64.0	23.9	8.2	3.9
Rural Non-Farm		100.0	72.7	19.6	5.5	2.2
Rural Farm		100.0	65.9	21.4	8.0	4.7
Philadelphia	1929	100.0	47.7	30.0	13.2	9.1
Metropolitan Life Ins. Co.	1930	100.0	55.9	26.7	10.5	6.9
Philadelphia	1931	100.0	49.3	27.3	13.8	9.6
Philadelphia	1932	100.0	48.2	26.8	14.6	10.4
Philadelphia	1933	100.0	49.5	26.5	13.7	10.3
Manhattan and Bronx	1934	100.0	67.9	21.7	7.2	3.2
Bridgeport	1934	100.0	52.3	28.2	12.0	7.5
Dayton	1934	100.0	68.3	23.8	5.9	2.0
Michigan, State	1935	100.0	75.7	18.3	4.6	1.4
Cities, 40,000 & Over		100.0	76.6	18.0	4.2	1.2
Cities, 3,000 to 40,000		100.0	76.0	18.6	4.2	1.2
Towns and Villages		100.0	73.6	19.6	5.1	1.7
Metropolitan Townships		100.0	78.1	15.9	4.3	1.7
Rural Townships		100.0	72.3	19.6	6.1	2.0
Philadelphia	1936	100.0	48.5	28.9	13.5	9.1

CHART II

RELATIONSHIP BETWEEN WORKERS UNEMPLOYED AND FAMILIES TOTALLY UNEMPLOYED



In case the proportion of one-worker families was below the standard (i.e., 1930 Census for the urban United States), the correction re-

duces the average rate of unemployment for all workers and increases the corresponding rate for families totally unemployed. This is due to the heavier weighting of the one-worker families who characteristically, as workers, enjoy a lower rate of unemployment, but who, as families, suffer a much higher rate of total unemployment than do multi-worker families. The reverse is, of course, true when the proportion of one-worker families is above the standard.

TABLE III

RELATION BETWEEN UNEMPLOYED WORKERS AND TOTALLY UNEMPLOYED FAMILIES

Number in Chart II	Date	Location	Percentages			
			Workers		Families	
			unadjusted rate	adjusted rate	unadjusted rate	adjusted rate
1	1929	Philadelphia	10.4	9.4	4.1	4.9
2	1930	Metro. Life Ins. Co.	23.2	21.7	10.9(e)	11.7(e)
3	1931	Syracuse	20.6	*	13.7	*
4	1931	Buffalo	24.9	*	15.8	*
5	1931	Philadelphia	25.3(e)	23.3(e)	11.9	13.5
6	1932	Philadelphia	41.8(e)	38.5(e)	23.6	25.8
7	1933	Philadelphia	46.0	42.3	27.7	29.8
8	1934	Manhattan and Bronx	27.9	28.1(e)	18.1	17.6
9	1934	Bridgeport	28.1	26.6	15.4	17.1
10	1934	Dayton	23.8	24.1	16.7	16.0
11	1935	Michigan Aggregate	17.4	18.7	12.1	11.1
11a		Cities, 40,000 & Over	17.9	19.5	12.9	11.6
11b		Cities, 3,000 to 40,000	16.8	18.8	11.5	10.4
11c		Towns and Villages	19.6	21.1	13.6	13.0
11d		Metropolitan Townships	15.2	16.2	11.0	9.9
11e		Rural Townships	18.0	18.5	11.8	11.4
12	1936	Philadelphia	30.1	28.4	17.0	19.4

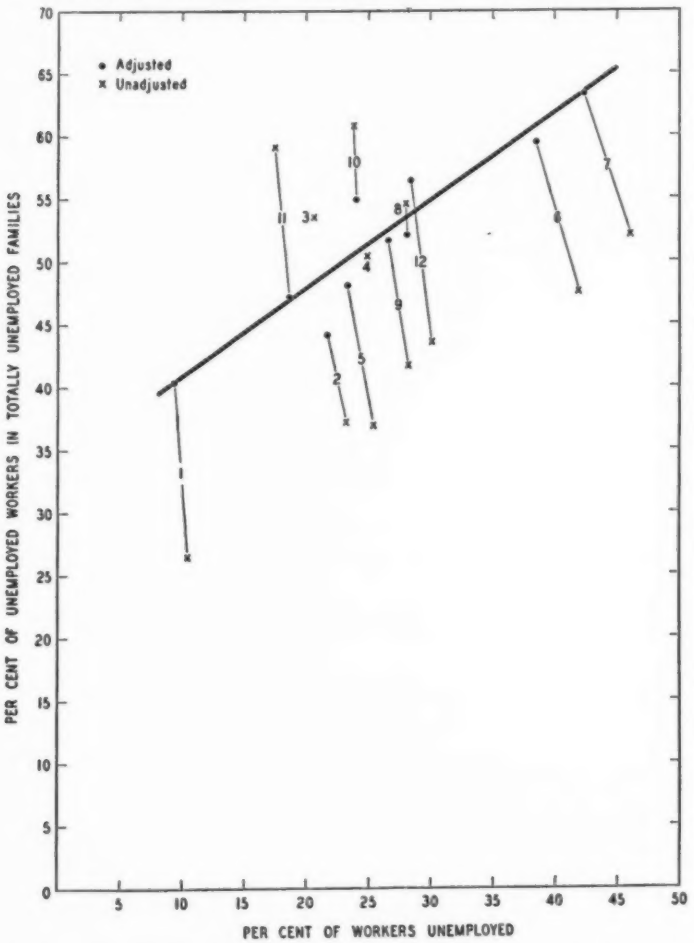
* Data were not available in sufficient detail to make the adjustment.
(e) Partially estimated.

Standardization of the rate of unemployment is essential in interpreting census data involving family groups. Consider, for example, the proportion of all unemployed workers who are in (a) totally unemployed families and (b) partially unemployed families. This proportion is in itself a function of the rate of unemployment. The higher the rate of unemployment, the larger the proportion of the unemployed who will be in totally unemployed families. In Chart III, the straight line which has been fitted free-hand shows that from 40 to more than 60 per cent of unemployed workers were in totally unemployed families. The standardized data appear reasonably homogeneous; the dispersion in the crude data, however, is very considerable.

Table IV shows the standardized and unadjusted data for Charts III and IV. When one-worker families are *under*represented, as in Philadelphia, the effect of the adjustment is (a) to reduce the total

CHART III

RELATIONSHIP BETWEEN WORKERS UNEMPLOYED AND PER CENT OF UNEMPLOYED WORKERS IN TOTALLY UNEMPLOYED FAMILIES



number of unemployed workers and (b) to raise slightly the number of workers in totally unemployed families, with the result that the ratio of unemployed workers in totally unemployed families to all unemployed workers is increased from 26 to 40 per cent. Vice versa, when one-worker families are *over*represented, as in Michigan, the effect of

the adjustment is (a) to increase the number of unemployed workers and (b) to reduce slightly the workers in totally unemployed families, with the result that the ratio is reduced from 59 to 47 per cent.

The reason the adjusted number of unemployed workers is higher than that given in the Census, when one-worker families are over-represented, is that the adjustment pushes a larger proportion of the total number of workers into the multi-worker families where the rate of unemployment for workers is higher. Likewise, the number of workers in totally unemployed families is reduced slightly by the adjustment because the number of totally unemployed families is itself

TABLE IV

PER CENT OF UNEMPLOYED WORKERS IN TOTALLY UNEMPLOYED FAMILIES AND AVERAGE NUMBER OF WORKERS PER TOTALLY UNEMPLOYED FAMILY

Item*	Per cent of unemployed workers in totally unemployed families**		Average number of workers per totally unemployed family***	
	Unadjusted rate	Adjusted rate	Unadjusted rate	Adjusted rate
1	26.5	40.3	1.283	1.181
2	37.2	44.2	1.353	1.266
3	53.6	—	1.246	—
4	50.4	—	1.262	—
5	36.9	48.1	1.472	1.278
6	47.9	59.5	1.643	1.365
7	52.1	63.4	1.648	1.385
8	54.6	52.1	1.240	1.282
9	41.7	51.7	1.360	1.240
10	60.8	54.9	1.232	1.274
11	59.1	47.4	1.123	1.197
12	43.6	56.4	1.451	1.274

* For identification see Table III.
** Chart III.
*** Chart IV.

reduced slightly (as in Chart II) when the proportion of multi-worker families is increased.

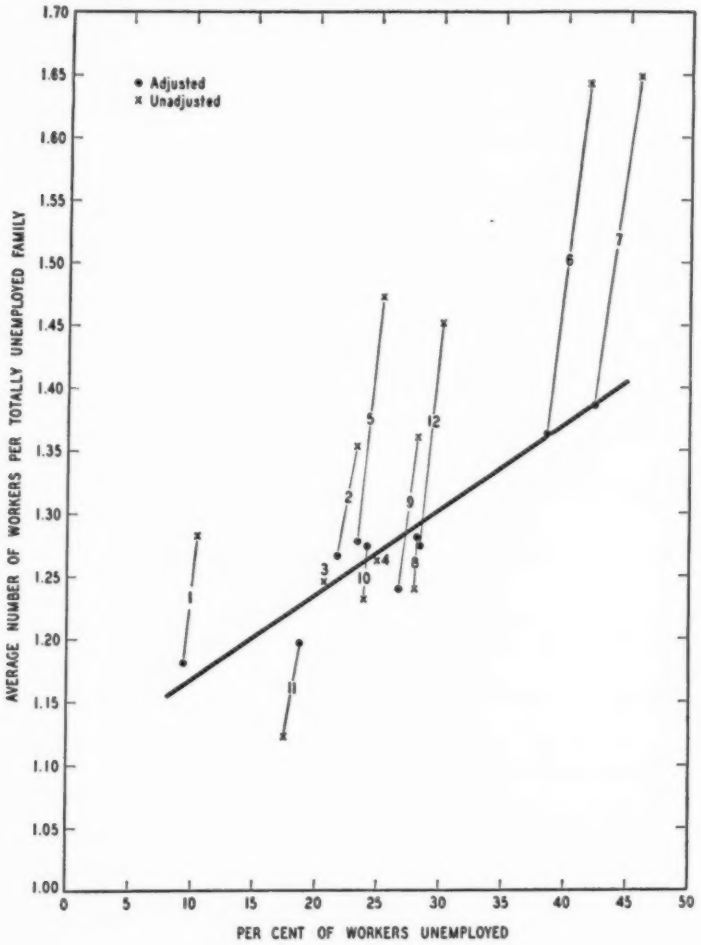
To complete the picture, consider the effect of standardization upon a third relationship, namely, the average number of workers per totally unemployed family. A moment's reflection will show that, due to the presence of multi-worker families, the average number of workers per totally unemployed family changes with the rate of unemployment. Chart IV indicates a rise from 1.17 to 1.38 workers per totally unemployed family as unemployment moves from 10 to 40 per cent.

In Philadelphia (1929), where one-worker families are *under*represented, the correction lowers the number of workers per totally unemployed family from 1.28 to 1.18. In Michigan, where the one-worker

families are *over*represented, the correction increases the number of workers per totally unemployed family from 1.12 to 1.20. The reason is that, in the latter case, while both the number of totally unem-

CHART IV

RELATIONSHIP BETWEEN WORKERS UNEMPLOYED AND THE AVERAGE NUMBER OF WORKERS PER TOTALLY UNEMPLOYED FAMILY



ployed families and the number of workers in them are lowered, the number of workers in totally unemployed families is reduced less than the number of totally unemployed families. This is because the adjustment increases the proportion of multi-worker families, where the

characteristic rates for family unemployment are lower but where the number of workers per family is obviously higher.

In case the distribution of family groups has changed since 1930, the standardization should, of course, be altered accordingly. Similarly, if the functional relationships shown in Charts II, III, and IV are wanted for individual cities or states, then the data should be standardized on a basis of the distribution of family groups in that particular community. In this manner these local censuses can be used as a basis for converting the number of unemployed workers into totally and partially unemployed families.

As unemployment grows, (a) the percentage of the unemployed who are in totally unemployed families increases, and (b) the average number of workers per family grows. Rough estimates of the number of families totally unemployed can be easily derived from the functional relationship in either Chart II or Charts III and IV.

To illustrate: assume that there are 7 million unemployed urban family workers with a corresponding labor supply of 28 million.[4] The rate of unemployment, then, is 25 per cent. Reading from Chart III there are 51.5 per cent of the 7 million unemployed, or 3,605,000, in totally unemployed families. According to Chart IV, there are 1.27 workers per totally unemployed family. The result is that 3,605,000 workers divided by 1.27 workers per family gives 2,839,000 totally unemployed families. The remaining 3,395,000 unemployed workers are in partially employed families.

Check this with the results obtained from Chart II. When workers are 25 per cent unemployed, families are 15.4 per cent totally unemployed. An urban labor supply of 28 million multiplied by 0.6495, which is the average number of families per urban worker,[4] gives 18.2 million census families. Of these families, 15.4 per cent, or 2,803,000, are totally unemployed, a negligible difference from the results obtained above.

To estimate the number of totally unemployed families without allowing for the difference indicated in Chart I will result in a serious overestimate. Assuming that workers in *all* family groups are 25 per cent unemployed, there would be not 2,803,000 but 3,276,000 totally unemployed families. This is because a straight rate of 25 per cent for workers in all groups results in 18 instead of 15.4 per cent of the families being totally unemployed.

Similarly, if the number of workers per totally unemployed family (Chart IV) is calculated without allowing for differences in the inci-

[4] This excludes the non-family workers as defined in the 1930 U. S. Census.

dence of unemployment (Chart I), the result is a serious understatement. For at a rate of 25 per cent there would be 1.10 workers per totally unemployed family, whereas the empirical data indicate 1.27.

Failure to correct the crude data will, obviously, lead to serious error. For example, the Philadelphia data show, again assuming unemployment to be 25 per cent, that less than 40 per cent of the workers were in totally unemployed families (Chart III). If weighted by the Detroit distribution of family groups, however, the adjustment of the Philadelphia specific rates would show more than 60 per cent of the unemployed workers to be in totally unemployed families.

These illustrations have dealt with family unemployment. The necessity for the standardization of census data is not, however, limited to these cases. In order to compare average rates of unemployment, the standardization will often be helpful. If the census shows 25 per cent of the workers in both Philadelphia and Michigan cities to be unemployed, it does not mean quite the same thing. If the rates for each city are "standardized" with regard to the distribution of family groups, then, due to the relationship shown in Chart I, there is a difference of about one-sixth between them.

There are, of course, many other differences, due to age, sex, nativity, and occupation, some of which are related to the multi-worker family differential. Crude data can be standardized for each of these factors also. The family has been emphasized because it appears to be a significant factor which has been neglected.

It scarcely need be added that the only occasion for standardizing the rates of unemployment is when data from one community are to be compared with data from another, or in generalizing from sample studies.

NOTES

INDEX OF MANUFACTURING PRODUCTION DERIVED FROM CENSUS DATA, 1935

By Vladimir S. Kolesnikoff

The index of physical volume of production of manufactures has recently been computed for the year 1935. This index compiled for the years 1914–1925 by E. E. Day and Woodlief Thomas[1] and for 1927–1931 by Miss Aryness Joy[2] has been revised for the years 1919–1933.[3]

The biennial index numbers on a 1919 base compared with the Federal Reserve Board index of manufacturing production are as follows:

Year	Index numbers 1919=100		Per cent change from preceding census year	
	Census	F.R.B.	Census	F.R.B.
1921	79.2	78.8	...	...
1923	122.7	119.5	+54.9	+51.6
1925	128.2	123.8	+ 4.5	+ 3.6
1927	127.9	125.1	− .2	+ 1.1
1929	145.1	141.2	+13.4	+12.9
1931	96.4	94.9	−33.6	−32.8
1933	89.2	89.2	− 7.5	− 6.0
1935	106.1	106.4	+18.9	+19.3

The index numbers for industrial groups and for individual industries are shown in the table on the next page. The index numbers and weights for industrial groups and for individual industries for the years 1919–1933 were given in this Journal for September, 1935.

Further details will be supplied on request.

[1] Census monograph "The Growth of Manufactures, 1899–1923."
[2] This Journal, Volume 25 (1930), p. 453 and Vol. 29 (1934), p. 305.
[3] This Journal, Volume 30, p. 581.

INDEX NUMBERS OF MANUFACTURING PRODUCTION BASED ON CENSUS DATA, 1935
(1919=100; Index for *All Industries*=106.1; Sum of weights=1000)

Industry	Index Numbers	Weights
I. FOOD AND KINDRED PRODUCTS	118.3	125
Butter, cheese and milk	150.6	15
Meat packing	94.9	42
Flour	72.4	20
Sugar, beet	164.3	4
Sugar, cane refining	119.6	6
Canned: fruits and vegetables	220.2	21
Canned: fish	143.7	3
Corn syrup, corn oil and starch	136.1	4
Ice, manufactured	116.9	10
II. TEXTILES AND THEIR PRODUCTS	114.4	167
Cotton goods	104.4	67
Knit goods	124.7	32
Silk manufactures	143.5	24
Woolen and worsted goods	108.1	35
Carpets and rugs, wool	113.4	6
Cordage and twine	111.1	3
III. IRON, STEEL AND THEIR PRODUCTS	92.1	233
Blast furnaces	69.3	19
Steel works and rolling mills	94.5	214
IV. LUMBER AND ITS REMANUFACTURES	57.2	66
Lumber and timber products	57.2	66
V. LEATHER AND ITS FINISHED PRODUCTS	106.0	37
Leather, tanned, curried and finished	90.1	12
Boots and shoes	114.5	25
VI. PAPER AND PRINTING	159.5	106
Paper and wood pulp	166.9	20
Printing and publishing	151.4	79
Paper boxes	251.5	7
VII. CHEMICALS AND ALLIED PRODUCTS	149.4	107
Chemicals and acids	169.8	24
Coke	78.9	5
Gas	97.5	16
Fertilizers	77.0	5
Explosives	66.8	3
Paint and varnish	143.3	12
Petroleum refining	295.1	27
Oil and cake, cottonseed	82.0	4
Turpentine and rosin	159.3	2
Salt	115.2	2
Soap	106.0	7
VIII. STONE, CLAY AND GLASS PRODUCTS	117.3	33
Clay products	46.3	10
Cement	95.7	7
Glass	229.3	16
IX. NONFERROUS METALS	95.8	40
Brass, bronze and other	110.9	12
Smelting and refining	79.6	8
Other industries	94.6	20
X. TOBACCO MANUFACTURES	137.2	16
Tobacco	80.8	3
Cigars	66.3	5
Cigarettes	263.5	8
XI. VEHICLES FOR LAND TRANSPORTATION	130.1	36
Automobiles	208.9	31
Carriages and wagons	13.7	1
Railway equipment	5.8	4
XII. SHIP AND BOAT BUILDING	2.0	12
XIII. RUBBER PRODUCTS	134.4	22
Tires and inner tubes	145.9	19
Boots and shoes	79.9	3

ACCIDENT STATISTICS

An American Standard for Compiling Industrial Injury Rates has been developed by the Sectional Committee on Compiling Industrial Injury Rates organized by the American Standards Association. The American Statistical Association is represented on this Committee by Dr. Eugene B. Patton. A new Standard just approved by the American Standards Association is a revision of a standard which goes back about 20 years and was published in 1920 in Bulletin 276 of the U. S. Bureau of Labor Statistics. In the development of this new Standard difficult problems of definition and rate making were encountered. Copies of the Standard may be secured at twenty cents each from the American Standards Association, 29 West 39th Street, New York, New York.

A revised Accident Cause Code has been developed by the Subcommittee of the Sectional Committee on Standardization of Methods of Recording and Compiling Accident Statistics of the American Standards Association under the chairmanship of Mr. H. W. Heinrich. The proposed code is distinguished by the following features:

(*a*) Mutually exclusive headings are provided.
(*b*) Headings are defined.
(*c*) Six factors, commonly admitted to be of major interest in accident prevention, are included for the first time in any code.
(*d*) Provision is made for separately recording the unsafe practices of persons, for the first time in any code.
(*e*) Provision is made for recording the reasons why persons act unsafely, for the first time in any code.
(*f*) Complete rules for application, extensive enough to cover all contingencies, are provided.

The coder is assumed to have before him a report of accident investigation, preferably one which is specially designed to bring out the facts to be recorded under the six specific headings. It is worthy of mention, incidentally, that trial has already shown that "run-of-the-mine" accident reports today, incomplete as they admittedly are, can be handled by the proposed code to good advantage.

The first task is the selection of an agency. In accordance with the rules, the coder determines what machine, object, or substance best identifies the accident. If he finds that the injured person sustained a fractured leg because of a fall over a loose and up-tilted plank in a floor while carrying a box so that it obscured his vision, he immediately names "wood floor" as the agency. This selection is made because the floor is defective and it caused the accident which in turn resulted in the injury.

The part of the agency is recorded as "none," inasmuch as the agency "wood floor" in the code has no "parts."

In coding "kind of accident" the coder finds at once that "Falls on level" fits the accident description exactly.

The coder then considers the matter of selecting the unsafe act or "performance of person." He notes in the accident description that the injured employee was carrying a box in such a manner as to prevent him from seeing where he was going, so he selects as the code item "Handling box unsafely."

Then follows the selection of a personal cause or reason for the violation of safe practice. If the report shows that the employee had been warned and instructed the coder selects "Willful disregard of instructions."

The determination of a mechanical cause is simple. There is nothing broken or weak, and guarding is not an issue—the coder thus selects "defective" as the correct item.

In narrative form the coded information can now be read as:

Employee, willfully disregarding instructions to carry material safely, falls on a defective wood floor and is injured.

In practical application the proposed code has been found to be workable and to produce results of greater specific value than could be obtained by use of other codes. It should go a long way towards meeting the growing and insistent demand for more and better factual data of value in the prevention of industrial accidents.

Whereas many codes used in the past have been attempts to include in a single list a number of important factors in the causation of accidents, the proposed code recognizes six different kinds of factors, each of which is usually represented in any single accident. The code provides for the recording and coding of the following classes of facts:

1. The agency—meaning the machine, tool, vehicle, animal, dust, gas, liquid, or other object or substance, that, chiefly because of its dangerous condition and the importance of the part it plays in causing the injury, best identifies the accident.
2. The agency part—meaning the particular part of the recorded agency of chief interest because of its dangerous condition.
3. The kind of accident—meaning the fall of a person, the fall of an object, caught in or between, struck by, or other event causing and immediately preceding or accompanying the injury.
4. The unsafe act of person—meaning the violation of a commonly accepted safe-practice rule, contributing to or resulting in the accident.
5. The personal cause or reason why a worker acts unsafely—meaning the willful disregard of instructions or other mental or physical characteristic permitting or prompting the violation.
6. The proximate mechanical cause—meaning the defect, or absence of guard, etc., causing the accident or contributing directly to it.

CONSOLIDATION OF THE DIVISION OF CURRENT BUSINESS STATISTICS AND THE DIVISION OF MANUFACTURES, BUREAU OF THE CENSUS

The Secretary of Commerce, under authorization contained in Section 601, Title 5, U. S. C., issued orders, effective October 25, 1937, for the consolidation of the Division of Current Business Statistics (Special Tabulations), headed by Mr. Thomas J. Fitzgerald, Chief Statistician, with the Division of Manufactures. The personnel of the Division of Current Business Statistics was transferred to the consolidated Division of Manufactures. Mr. Fitzgerald has been appointed Chief Statistician of the Division of Manufactures.

By transfer from the Central Statistical Board, Mr. Howard H. McClure has been appointed Assistant Chief Statistician of the Division of Manufactures. Under the reorganization there will be ten professional technical positions in the division.

Mr. LeVerne Beales, Chief Statistician of Manufactures, was transferred as of the same date to the Division of Territorial, Insular, and Foreign Statistics as Chief Statistician.

Mr. Ray Hurley, who has been Assistant Chief Statistician of the Division of Territorial, Insular, and Foreign Statistics (Acting Chief Statistician), is at present on loan to the President of the Commonwealth of the Philippines as a technical consultant in connection with the census of the Philippines, and is expected to return to his position of Assistant Chief Statistician of this Division prior to the Decennial Census of 1940.

Mr. John F. Daly, Assistant Chief Statistician of the Division of Manufactures, has been designated Technical Assistant to the new chief and assistant chief of the consolidated division.

The compilation and publication of the *Statistical Abstract* has been transferred, by order of the Secretary, from the Bureau of Foreign and Domestic Commerce to the Bureau of the Census, and will be under the immediate supervision of Mr. LeVerne Beales.

In connection with the current business statistics, other than those specifically provided for by special acts, a cooperative arrangement has been set up by the Secretary of Commerce between the Bureaus of Census and Foreign and Domestic Commerce whereby the Bureau of the Census will collect and tabulate the material, and the Bureau of Foreign and Domestic Commerce will analyze and interpret the results. The publications will be issued by the Department of Commerce under the Secretary's signature, with joint responsibility and credit being given to both the Bureau of the Census and the Bureau of Foreign and Domestic Commerce.

In the working out of plans for cooperation, the preparation of schedules, and the conduct of the inquiries, a committee has been appointed made up of two representatives from the Bureau of Foreign and Domestic Com-

merce, Dr. Nathanael H. Engle, Assistant Director, and Dr. Wilford L. White, Chief of the Division of Marketing Research and Service; and two from the Bureau of the Census, Dr. Vergil D. Reed, Assistant Director, and Mr. Thomas J. Fitzgerald, Chief Statistician of the Division of Manufactures; with a fifth member representing the Central Statistical Board. At present the representative of the Central Statistical Board is Dr. Morris A. Copeland, Executive Secretary of the Board.

OLIVER C. SHORT
Assistant Director

Bureau of the Census
Department of Commerce

PROGRESS OF WORK IN THE CENSUS BUREAU

PUBLICATION OF THE 1935 CENSUS OF MANUFACTURES

The preparation of the final reports of individual industries enumerated in the 1935 Census of Manufactures was completed in August, 1937, the last of the manuscript being sent to the Government Printing Office near the close of that month. These reports, which were issued in a series of 53 octavo pamphlets, each covering a small group of closely related industries, will constitute the greater part of the final report of the Census of Manufactures, to be published in a cloth-bound octavo volume of approximately 1,300 pages. As the last of the industry reports was not received from the Government Printing Office until November, it was impossible to print the volume itself in 1937.

Two series of State reports (multilithed) have been issued, one giving summary statistics by industries, and the other, summary totals for cities and counties. Another series of reports gives statistics by industries for 32 industrial areas.

Statistics of establishments classified by size as measured by the number of wage-earners employed have been published in multilithed tables giving the total number of wage-earners and the total number of establishments in each size group. The figures, which cover 1933 as well as 1935, are shown by industries and by states. This will be the first tabulation of the kind to be published since the census of 1929.

CENSUS OF ELECTRICAL INDUSTRIES

The Bureau is getting ready for the next quinquennial census of electrical industries which will cover the calendar year 1937. The questionnaires have been revised to meet the changes that have occurred in kinds of operations since the last census. They apply to the following types of industries: (1) telephones (connecting lines and systems), (2) telephones (operating companies), (3) street railways (operating companies), (4) street railways (non-operating and lessor companies), (5) motor-bus operations, (6) trolley-bus operations, (7) telegraphs, and (8) electric light and power industry. Separate schedules for radiotelephones and radiotelegraphs are being considered.

FINANCIAL STATISTICS OF STATES AND CITIES

The 1935 report on Financial Statistics of Cities of over 100,000 Population (175 pages) was issued in September; and press releases for 1936 have been issued for most of the cities. The schedules as revised for 1936 called for more detailed statistics on certain subjects, including grants-in-aid and relief expenditures, method of financing outlays, tax collections and delinquency, interest rates on bonds, and number of city employees by departments.

The Bureau, in cooperation with the Treasury Department, Division of Research and Statistics, made an inquiry on state and local debt in 1937

including status of sinking and trust funds, and related data. The inquiry covered all states, 607 counties, 983 cities of over 10,000 population, and 264 districts (i.e., port, bridge, road, and irrigation); also debts of school districts as of June 30, 1936, as reported by states to the Office of Education.

In cooperation with the Bureau of Foreign and Domestic Commerce, an inquiry on chain-store tax collections has been made in 17 states.

CENSUS OF AGRICULTURE, 1940

Preparations are being made for the 1940 census of agriculture. A trial schedule has been printed and instructions to enumerators prepared. In addition, considerable exploratory work is being done using census data by minor civil divisions to determine the best method of sampling. Much attention has been given to answering inquiries which arise from farm mapping programs, research projects, and other questions brought up by the expanding use of farm census statistics.

VITAL STATISTICS

The fourth volume of the *Vital Statistics—Special Reports* series giving state summaries of vital statistics for the year 1936 is now being published. Two new tables have been included. One is a table for the year 1935 distributing births and deaths according to place of residence. This gives the total number of births and deaths and the number of non-resident births and deaths occurring in each city and in the rural area of each county; the number of residents of the city or rural area born or dying elsewhere either in the same state or in other states; and the total number of births and deaths of residents wherever occurring.

This is the first time that it has been possible to make a complete allocation of births and deaths in the United States according to place of residence. It is of course not possible to do that until the returns are available for all states; and that is the reason why in the current series of state summaries the complete allocation is given for 1935 but not for 1936. However, an allocation by residence limited to births and deaths occurring within the state is presented for 1936 as it has been for previous years.

The other new table referred to above gives for the state the deaths from cancer distributed according to the principal anatomical site of the tumor.

J. A. H.

STATISTICAL NEWS AND NOTES

CENTRAL STATISTICAL BOARD.—*Current Business Inquiries in the Department of Commerce.* The Secretary of Commerce on March 20, 1937, requested the Central Statistical Board to make recommendations with regard to the work of collecting and compiling various current business statistics within the Department of Commerce. In response to this request, the Central Statistical Board established a committee composed of Messrs. Frederick C. Mills, Columbia University (Chairman); Walter White, Assistant to the Chairman of the Business Advisory Council for the Department of Commerce; and O. C. Stine, Chief, Division of Statistical and Historical Research, Bureau of Agricultural Economics. A representative of the Bureau of the Budget sat with the Committee.

The Committee invited representatives of the Bureau of the Census, the Bureau of Foreign and Domestic Commerce, other interested Federal agencies, and several trade associations to present facts and to make suggestions. Its report which was submitted to the Secretary of Commerce on May 29, 1937, recognized "that any final determination regarding the assignment of functions will necessarily involve questions of an administrative character of which the Committee has not been expected to take account." The report, in brief, recommended:

1. "As a long-run policy, and with exclusive reference to the activities of the Bureau of the Census and the Bureau of Foreign and Domestic Commerce, the functions of collection and primary compilation of current data respecting domestic business activity should be assigned chiefly to the Bureau of the Census, these duties to be combined in detailed assignments with those involved in the conduct of business census enumerations . . . "

2. "As a matter of policy and with exclusive reference to the activities of the two bureaus, the functions of analyzing and interpreting current business conditions and economic developments and of selective publication of current business and industrial data should continue to be assigned chiefly to the Bureau of Foreign and Domestic Commerce. . . "

3. "The proper development of a new current reporting service calls for a large measure of analytical work. As an example, the Committee cites the current situation in the collection of monthly data on wholesale and retail trade. Until a standardized working procedure has been developed, the Bureau of Foreign and Domestic Commerce should probably continue these services. When they have been more fully organized it may be expected that the task of analysis will require the full attention of the personnel engaged in this field by the Bureau of Foreign and Domestic Commerce, and that collection and compilation may be delegated to the Bureau of the Census. . . "

4. "It is assumed that the compilation of statistics on foreign trade and international capital movements will continue in the Bureau of Foreign and

Domestic Commerce, and that the Bureau will continue to conduct special statistical inquiries from time to time in the field of domestic business."

Supplementing these specific recommendations, the Committee emphasized the importance of "close and continuing cooperation between the two bureaus in the development and prosecution of a well-balanced and competent program of current business reporting" and the importance of recruiting professional personnel adequate to the needs of such a program.

Participation in the Census of Partial Employment, Unemployment and Occupations. At a meeting of the Central Statistical Board, on October 8, the following resolution was unanimously adopted:

> "Whereas, the Congress has directed the President to take a census of partial employment, unemployment and occupations, to meet the urgent need for information about the problems of reemployment, social security and unemployment relief; and
>
> "Whereas, the President has emphasized the utmost importance of securing a complete, honest and accurate count; and
>
> "Whereas, it is a function of the Central Statistical Board to investigate and make recommendations with respect to statistical work carried on by Federal agencies; therefore
>
> "Be it resolved that the Central Statistical Board offers to the Administrator of this census its full cooperation toward the successful attainment of the objects of the census; and
>
> "Be it further resolved that the Central Statistical Board believes that it can cooperate most effectively by establishing a special committee, supported by a special section of the Board's staff, to aid and advise the Administrator and his technical staff."

The Committee which was established by the Board in accordance with the above resolution is composed of the following persons: Mr. Stuart A. Rice, Chairman of the Central Statistical Board, Chairman; Mr. W. L. Austin, Director of the Bureau of the Census; Mr. E. Dana Durand, Commissioner of the Tariff Commission; Mr. Corrington Gill, Assistant Administrator in charge of Research, Statistics and Finance of the Works Progress Administration; Mr. Oscar E. Kiessling, Chief Economist, Mineral Resources and Economics Division, Bureau of Mines, Department of the Interior; Mr. Isador Lubin, Commissioner of Labor Statistics; Mr. Frederick F. Stephan, Secretary-Treasurer, American Statistical Association; Mr. Morris A. Copeland, Executive Secretary of the Central Statistical Board; and Miss Aryness Joy, Chief Economist of the Central Statistical Board, Secretary. The suggestions made by this committee are being transmitted to Mr. Biggers, Administrator of the Census of Partial Employment, Unemployment and Occupations.

Curtailment of the Appropriation of the Central Statistical Board for the Fiscal Year 1938. In June of this year Congress cut in half the appropriation for the work of the Central Statistical Board in the fiscal year 1938. The Board is currently operating with half the funds spent in each of the

three preceding years. Consequently, it has been necessary to curtail its staff and work drastically.

A number of important activities have been abandoned entirely; other responsibilities are being met only in special cases. The direct participation of the Board in the joint review and supervision of statistical projects carried on under the Works Program through a committee known as the Coordinating Committee of the Central Statistical Board and the Works Progress Administration has been discontinued and the Committee dissolved. The review of statistical releases and publications, over 400 of which were examined during the 1937 fiscal year, has also been practically stopped. The work of assembling descriptions of statistical data available in various fields and of reviewing research in process has been dropped for the year. The weekly review of economic conditions, prepared by the Board in cooperation with other Government agencies since April 1935 for broadcasting to our embassies abroad and for circulation to Government executives, has been discontinued. Various types of requests are now granted only under exceptional circumstances.

In the past the Board has been called on frequently to make special inquiries into administrative problems of the statistical services, to provide technical advice and assistance on inquiries in process and for the improvement of statistical data collected regularly by the Federal Government, and to prepare special reports on various aspects of current economic and social conditions for the use of the President, members of the Cabinet, and heads of executive agencies. The Board is continuing to work on a number of projects started in earlier years, but beyond these it will probably be necessary to postpone practically all requests until next year.

Continuation of some of the Board's work has been made possible by arrangements for the reimbursement of the Board for the time of its staff by specially interested agencies. For example, the Bureau of Labor Statistics is reimbursing the Board for the continuation of technical advice in the Study of Urban Consumers' Purchases. Another member of the Board's staff is continuing his work in the field of mineral statistics, with the help of the Bureau of Mines. Still another staff member has been enabled to continue the advisory assistance which the Board has been giving the Civil Service Commission in connection with the rating of the Social Science Analyst examination by a similar arrangement. As previously noted in this JOURNAL, the Board has also been assisted in meeting its financial problems by arrangements with the National Resources Committee for the preparation of a Government chart book of current economic and social series, including descriptive and critical comments. A substantial share of the time of the staff during the past few months has been devoted to preparing this chart book in cooperation with the National Resources Committee.

From a long run point of view, the most important project of the Board, which has been continued largely by the assistance of other agencies, is the

development of a standard classification of industries. It is hoped that this classification, which is now not far from completion, will be adopted by the Census Bureau, the Bureau of Labor Statistics, and the Social Security Board immediately on its completion, and that other agencies will then fall in line.

The Board is continuing its regular review of questionnaires and plans for statistical inquiries. These reviews have been a major part of the Board's work since its inception and are the basic means through which it exercises its coordinating functions.

DOMINION BUREAU OF STATISTICS, CANADA.—*Financial Statistics.* From July 19th to 22nd, 1937, a Dominion-Provincial Conference on Municipal Statistics was held in Ottawa to study the different phases of the problem of the uniform presentation of municipal statistics, a subject which falls within the administrative jurisdiction of the Provincial Governments under the Canadian Constitution. The Provincial Governments were all represented and in addition the Canadian Federation of Mayors and Municipalities, the Municipal Finance Officers' Association of the United States and Canada, the Ontario Mayors' Association, and a number of leading cities also sent delegates. The Dominion Government was represented by officials from the Dominion Bureau of Statistics, the Department of Finance, the Department of Labour and the Bank of Canada. Dr. R. H. Coats, Dominion Statistician, was nominated Chairman.

The Conference decided upon uniform methods of accounting, statistical practice, and terminology. Agreement was reached on the exchange of such information as would facilitate this purpose.

The Dominion Bureau of Statistics was requested to undertake, in cooperation with the provincial Departments of Municipal Affairs, a study of existing legislation and the forms at present in use for the collection of municipal statistics throughout Canada with a view to the classification of different types of local government units.

Continuing subcommittees were constituted to deal with particular problems, including: (a) general municipal statistics; (b) revenue, expenditure and classification of municipal accounts; and (c) assessment and population matters.

NATIONAL RESOURCES COMMITTEE.—*Report of Urbanism Committee.* Released under the title "Our Cities—Their Role in the National Economy," the report contains a number of recommendations approved in principle by the National Resources Committee, which, if carried out, would enable the Federal Government to concern itself with city dwellers as it has with farmers through the Department of Agriculture.

The major recommendations follow, in part:

> That the efforts already made by government, industry and labor toward increasing economic security be intensified and that the United States

both study and act upon the problems of chronically depressed urban areas.

That the Federal Government should continue its policy of assistance to the social welfare programs of urban communities.

That a section for urban research be set up in some suitable Federal agency which would perform for urban communities functions comparable to those now performed for rural communities by the Department of Agriculture.

That a clearing house of urban information should be created in the Bureau of the Census which would serve as a central depository of all information about urban communities collected by all governmental agencies and by authoritative private organizations.

That the Central Statistical Board should give special consideration to the inadequacies in the existing urban data.

That a comprehensive and thorough-going inquiry should be made by the present tax revision council or other suitable agency of the entire subject of conflicting fiscal policies and taxation in local, State, and Federal Governments.

That Congress should pass legislation laying down the conditions under which there may be adopted interstate compacts enabling the several communities within the same metropolitan region, but in separate States, to deal jointly with the regional aspects of health, sanitation, industrial-waste regulation, etc.

That legislation should be considered primarily for periods of economic distress creating a Federal credit agency authorized to make loans and grants under adequate legislative safeguards to local governments for the purposes of public works construction, acquisition or construction of public utilities, land purchases, and similar outlays. At the same time, the Committee believes that direct Federal expenditures in cities should be reduced to a minimum.

Report of the Science Committee. The first report on the science resources of the United States (entitled "Technological Trends and National Policy") deals with new inventions and their social implications and calls attention to the need for planning to meet the new situations caused by technological advance.

Prepared by a large group of scientists and engineers, the report "presents a survey of most of the great fields of technology and applied science, namely, agriculture, mining, transportation, communication, the construction industries, power production, the metallurgical and chemical industries and the electrical manufactures.

"The purpose is to cover a wide range; for the specialization so necessary for progress needs to be accompanied by broader vision. It was possible to obtain this wider perspective by dealing only with the more significant inventions. Since inventions were selected for this report on the basis of their social significance, omissions are important as truly as inclusions,

especially as the surveys were conducted by competent authorities in the different fields."

"It has been thought best to focus on the near future, which is defined as the next twenty years; but any blinders that cut off sharply the present, the more distant future, or even the recent past, would mean an inadequate investigation, since change is a process."

A Federal Committee should be responsible, according to the report, for keeping abreast of technological changes and for forecasting imminent changes that may affect national life. This Federal group should be composed of representatives of the Departments of Labor, Commerce and Agriculture, the Bureau of Mines, the Interstate Commerce Commission, the Social Security Board and the Works Progress Administration with such cooperation from industry and research organizations as may be necessary to obtain complete information.

The National Resources Committee also urges that a series of continuous studies, independent of the Joint Committee of Federal agencies, be undertaken by existing planning boards and by appropriate agencies developed by the Federal Government—and, more specifically, that there be set up, in the various interested departments, science committees with the definite function of investigating and reporting on the progress and trends of science and invention and the possible social and economic effects which may follow them.

It is recommended that these agencies, with the aid of such natural and social scientists as may be needed, concentrate their initial efforts on the following inventions which promise to play an immediate part in future technological changes; the mechanical cotton picker; air conditioning equipment; plastics; the photo-electric cell; artificial cotton and woolen-like fibers made from cellulose; synthetic rubber; prefabricated houses; television; the automobile trailer; gasoline produced from coal; steep-flight aircraft and tray agriculture.

BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM.—The August issue of the *Federal Reserve Bulletin* contained tabulations showing the distribution of commercial banks in the United States as of December 31, 1935, by states and geographical divisions on the basis of the amount of loans and investments, amount of deposits, ratio of demand to total deposits, ratio of total capital account to total deposits, and according to the population of the city in which located. The tabulations also included special analyses of banks not on the Federal Reserve par list and of banks with capital stock less than the applicable minimum statutory requirements for Federal Reserve membership or for the establishment of national banks. The September issue of the *Bulletin* contained tabulations analyzing in detail the number, deposits, and loans and investments of suspended banks by geographic divisions, states, months, years, size and class of bank, and size of town, for the period from 1921 through 1936.

In connection with a discussion of gold and capital movements in the last quarter of 1936 and the second quarter of 1937, there was published in the *Federal Reserve Bulletin* for August 1937 a table on the sources and uses of gold from January 1931 to June 1937. The table shows, on an annual basis, the amount of gold derived from new production and other sources, the absorption of gold into central reserves and industrial uses, and the indicated increase or decrease in unreported official holdings or private hoards in western countries. The discussion of capital movements in the August *Bulletin* was based on data collected by the Federal Reserve banks for the Treasury. These statistics, covering the first quarter of the year, were published in the *Bulletin* for July, and those for the second quarter in the *Bulletin* for October. Similar data for the period May 1929—December 1936 were published in the *Bulletin* for May.

DIVISION OF RESEARCH AND STATISTICS, FEDERAL HOME LOAN BANK BOARD.—For more than two years an index of the total cost of constructing a standard 6-room frame dwelling has been compiled through the cooperation of field representatives in more than 90 selected cities. This cost index includes the price of building material delivered to the site, the total charges for labor required to complete the construction, and compensation insurance, as well as a percentage of profit for the contractor. The information is reported every three months for four different groups of cities, so that a particular cycle of building cost indexes is available each month. Since January 1936 these indexes have been published in the *Federal Home Loan Bank Review*, and each subsequent issue has reprinted the index figures for each of the previous periods.

Since January 1936 this Division has been collecting from approximately 2,500 savings, building and loan associations, monthly reports showing the total volume of mortgage loans made during the month, with a breakdown as to the purpose for which the loan was made. The material is segregated by states and also as to federal associations, state-chartered building and loan associations which are members of the bank system, and non-member institutions. On the basis of reports received from the cooperating associations this Division has prepared estimates of the total volume of new mortgage loans made by all *active* savings and loan associations in the U. S., and in each of our Federal Home Loan Bank Districts.

BUREAU OF FOREIGN AND DOMESTIC COMMERCE.—The foreign section (Part II) of the *World Economic Review*, separated for the first time from the United States section, has been recently released. The study presents a review of the economic policies and developments during 1936 in the principal countries of the world. The study reveals that although a certain degree of recovery has been found in most countries, the elements of uncertainty, distrust, and isolation still operate in many areas to prevent a complete return to prosperous conditions. The economic effects of rearmament, of

the self-sufficiency programs which are characteristic especially of totalitarian states, and of currency readjustments are discussed in detail. Special attention is given to the recovery in international trade and the extent to which the gains are concentrated in the export trade of producers of raw materials and staple foodstuffs. The few instances of liberalization of commercial policy are noted, but these are confined principally to the broadening of quotas and reductions of duty in connection with currency devaluations in the European area. The more encouraging developments of the year are to be found in the trend toward elimination of currency uncertainties, although the gain in nominal foreign-trade returns as a result of devaluation is largely illusory. Tables in the appendix showing month-by-month production of a few primary minerals and metals reflect both the gradual general recovery and the progressive extension of armament programs. Such sub-headings as industrial production and profits, prices, cost of living, unemployment, wages, agriculture, foreign trade, public finance and private finance characterize the treatment of each nation. Statistics upon each of these important subjects are also given.

The November issue of the *Survey of Current Business* carried a special treatment of "Farm Mortgage Credit 1930–1937" by Norman J. Wall and Frederick M. Cove. The article is based primarily upon a report of the co-operative survey by the Bureau of the Census and the Bureau of Agricultural Economics, entitled "Farm Mortgage Indebtedness in the United States" and a preliminary report on "Outstanding Farm-Mortgage Loans of Leading Lending Agencies." This latter study is to be issued by the Bureau of Agricultural Economics. The article shows the decline in farm mortgage indebtedness as well as the reduction in the number of farms mortgaged, both tenant and owner occupied. The shifting of mortgages due to the refinancing program of the Farm Credit Administration and the consequent effect upon the volume of farm holdings by various types of financial institutions is also revealed.

Summary statistics on national income 1929–1936 have been recently released. This publication brings up to date and revises certain materials contained in the more detailed publication,—*National Income 1929–1935.* Data are presented for income produced and paid out during this period with detailed information as to types and sources of both payments and receipts.

On September 1 the Bureau extended its program of collecting current statistics for independent retailers to eleven additional states. The information at the present time is confined to sales data and monthly releases are issued showing the percentage change in sales by kinds of business from a corresponding month a year ago and from the previous month. These releases also show the changes in total sales by cities and city size groups.

FEDERAL TRADE COMMISSION.—A second report under the Commission's agricultural income inquiry entitled "Fruits, Vegetables and Grapes, Agri-

cultural Income Inquiry," was submitted to Congress in June 1937. This report was made by direction of Public Resolution No. 112, 74th Congress amending the earlier resolution authorizing the inquiry into principal farm products, on which a report was made to Congress in March 1937. The scope of the later inquiry and report was similar to that of the earlier but conditions and conclusions reported greatly differ.

The concentration of handling fresh fruits and vegetables is not significant except in the case of a few cooperatives and other shippers. The California Fruit Growers Exchange, The Florida Citrus Exchange and Mutual Orange Distributors, together marketed 62.85 per cent of the total 1935 production of oranges for fresh distribution. The California Fruit Exchange handled 12.22 per cent of the 1935 grapes distributed fresh and The DiGiorgio Fruit Corporation 10.3 per cent. The Atlantic Commission Company, a subsidiary of the Great Atlantic and Pacific Tea Company, was a large distributor of both fruits and vegetables, but had a smaller percentage for any one item than those cited.

A high degree of concentration was reported in the processing of fruits and vegetables. Three reporting canners together processed from 30.55 per cent to 67.07 per cent of various fruits and vegetables produced in 1935 and used for commercial canning.

For 10 selected fresh fruits and vegetables combined, the growers' portion of the consumer's dollar paid to chain stores in 11 terminal markets was 32.24 cents; distributors' margins were 33.62 cents, including a retail margin of 29.35 cents; freight and other transit costs, 21.59 cents; and packing, loading, storage and miscellaneous costs, 12.55 cents.

A study was made of the investments and profits of fruit and vegetable processors, of the operations and results shown by cooperatives, and of the many alleged unfair and wasteful methods of distribution of fresh fruits and vegetables in the large terminal markets, and several recommendations for improvement through legislation or otherwise were made.

Neither of the reports on agricultural income have been printed but both are available for examination at the Commission's offices. A summary of the earlier report, together with conclusions and recommendations, may be obtained from the Commission in printed form, and the same for the later report may be had in mimeographed form.

COMMODITY EXCHANGE ADMINISTRATION, U. S. DEPARTMENT OF AGRICULTURE.—The Commodity Exchange Act of 1936 considerably enlarged the scope of the Commodity Exchange Administration. The work of this organization now deals with the regulation of future trading in wheat, cotton, rice, corn, oats, barley, rye, flaxseed, grain sorghums, millfeeds, butter, eggs, and potatoes. A Division of Statistics has been established, and plans are being laid for the release daily of information on volume of trading and open contracts in other commodity futures in addition to the data now being released on grain futures. It is expected that the monthly publication,

Trade in Grain Futures, will be expanded to present in detail statistical information on other commodities as well as grain.

Starting August 2 new regulations dealing with daily reports of the trades and open interests of large traders in grain futures went into effect. On October 1 similar regulations became operative for cotton, butter, eggs, potatoes, and millfeed. Plans are under way to provide for periodic release of tabulations based on these reports. When all these plans are put into effect the public will have far more complete information on operations on organized commodity markets than have been available in the past or are available for the commodity markets of any other country.

U. S. BUREAU OF MINES.—With the close of the fiscal year ended June 30, 1937, the Bureau of Mines relinquished to the National Bituminous Coal Commission the collection of statistics relating to the coals subject to the jurisdiction of the Bituminous Coal Act of 1937. The Bureau, however, will continue to collect data on accidents occurring at all coal mines. Broadly, the Bureau of Mines retains jurisdiction over the collection of statistics relating to anthracite, semi-anthracite and lignite coals, coke, fuel briquets and packaged fuel, and the international coal trade.

As a part of its improved service to the fertilizer industries, the Bureau recently inaugurated a semi-annual report of phosphate rock which provides a new base line on fertilizer sales. The first report of this series covers the period January 1–June 30, 1937.

A physical inventory of stocks of crude oil in the United States was made during the fiscal year ending June 30, 1937, and a preliminary report of the results was published July 13, 1937. The primary objective of the study was to ascertain the volume of stocks above ground and to determine the quantities of light fractions in the various stocks, especially those which had been in storage for a considerable time.

As a result of cooperative studies on mineral technology and output per man by the Bureau of Mines and the Works Progress Administration, as a part of the National Research Project on reemployment opportunities and recent changes in industrial techniques, the following reports have been published in recent months:

Technology and the Mineral Industries by F. G. Tryon, T. T. Read, K. C. Heald, G. S. Rice, and Oliver Bowles, (Report No. E-1. April 1937);

Small-Scale Placer Mines as a Source of Gold, Employment, and Livelihood in 1935 by Charles White Merrill, Charles W. Henderson, and O. E. Kiessling, (Report No. E-2. May 1937);

Mechanization Trends in Metal and Nonmetal Mining as Indicated by Sales of Underground Loading Equipment by L. N. Plein, F. E. Berquist, and F. G. Tryon, (Report No. E-3. June 1937);

Employment and Related Statistics of Mines and Quarries, 1935 Part I—*Bituminous Coal*, by F. G. Tryon, W. H. Young, M. E. Wilson, and F. E. Berquist;

Part II—*Pennsylvania Anthracite*, by F. G. Tryon, M. Otero, W. H. Young, and D. C. Ashmead, (Report No. E-4. July 1937).

AGRICULTURAL ADJUSTMENT ADMINISTRATION.—*Agricultural Conservation Program for 1938*. The outline of the 1938 Agricultural Conservation Program was announced on September 20, 1937. Under this program, acreage goals are established for corn, cotton, flue-cured, Burley, fire-cured, dark air-cured, and cigar filler and binder tobaccos, peanuts, rice, potatoes, and general soil-depleting crops; and provision is made for establishing individual farm goals for each of these crops or groups, as well as for soil-building crops and practices which should be carried out on the farm. The national goals for soil-depleting crops in comparison with 1928–37 average acreages are:

Crop	*Acreage*	
	1928–37 (Thousand Acres)	1938 Goal (Thousand Acres)
Corn	102,468	92,000– 96,000
Cotton	36,858	27,000– 29,000
Rice	900	825– 875
Tobacco		
Flue-Cured	924	850– 900
Burley	394	480– 500
Fire-cured and Dark Air-cured	231	170– 180
Cigar filler and binder	98	85– 90
Peanuts	1,544	1,500– 1,600
Potatoes	3,346	3,100– 3,300
General	157,480	145,000–155,000
All Soil-Depleting*	305,000	273,000–288,000

* Sugar beets and sugarcane included.

County goals for cotton, tobacco, and rice will be established for each county where such crops are grown; and county goals for corn, potatoes, and peanuts will be established only for those counties which are in the principal commercial producing areas designated by the Agricultural Adjustment Administration.

County committees will establish soil-depleting and soil-building goals for individual farms, taking into consideration the tillable acreage on each farm, the type of soil, topography, production facilities, crop rotation, acreages customarily grown and acreages of food and feed crops needed for home consumption, acreage of new seedings, and the extent to which liming, terracing, contour listing, and other soil-conserving or erosion-control practices are needed to promote agricultural conservation.

A maximum payment will be calculated for each farm. Payment will be made for keeping within the general soil-depleting goal and the individual crop goals, and for attaining the soil-building goal established for the farm. Where the soil-depleting goal is exceeded or the soil-building goal is not

reached, the payment will be less than the maximum payment. The payments will be divided between landlords and tenants in the proportion that they share in the principal crop, or all crops and practices on the farm. Specific provisions applicable to the Great Plains area encourage the restoration to grass of land which should never have been plowed.

The same administrative set-up will be used as in the past. This involves the county agricultural conservation associations as the local administrative agencies working under the direction of State committees, which are in turn responsible to the Regional Divisions of the Agricultural Adjustment Administration. Since the actual appropriation has not been made, the 1938 program is dependent upon the action of Congress, although in 1936 Congress authorized an annual appropriation for carrying out such a program under the Soil Conservation and Domestic Allotment Act.

BUREAU OF LABOR STATISTICS, U. S. DEPARTMENT OF LABOR.—A survey of paid vacation practices in American industry is being made by the Bureau. The survey includes both salaried employees and wage earners and will cover both manufacturing and nonmanufacturing establishments. It will deal with such points as the extent to which paid vacations are being granted; the length of the vacation period; the method of computing service; the time of year when granted; and the method of remuneration.

The wage survey of the bituminous-coal industry is well advanced, two articles having already been published in the *Monthly Labor Review*, one dealing with annual earnings and the other giving summary data, by states. In connection with the survey of the cotton-textile industry it is expected that preliminary results will be available shortly. A study of wages, hours, and annual earnings in the radio and phonograph manufacturing industry is in progress, covering about half the industry. This will be followed by a similar study of the electrical machinery and apparatus industry. A report on wages and working hours in the quarrying and finishing of granite is practically finished. Data were obtained for 185 establishments having 5,400 employees and representing 50 per cent of the entire industry. The Bureau's usual annual survey of entrance wage rates of common unskilled labor was made as of July 1, 1937. Twenty industries and more than 5,000 establishments, having over 200,000 employees, were included this year. The annual survey of union-wage scales as of May 15, 1937, has been completed. The preliminary results for the building trades appeared in the *Monthly Labor Review* for November 1937.

Arrangements are being made for a study comparing contract prices for construction projects with permit valuations, in order to ascertain how closely valuations quoted when building permits are obtained approximate actual construction costs. The coverage will be 25,000 residential buildings for which the Federal Housing Administration has issued commitments to insure. Tabulations will be made by building-cost groups and by cities.

In connection with the Bureau's regular reports on employment and pay

rolls in manufacturing and nonmanufacturing industries, the statistics are being broken down by sex for 38 manufacturing industries, laundries, and cleaning and dyeing establishments. The industries selected for such analysis are those where a large number of women are employed. It is planned for the future to prepare such reports semi-annually, in March and September.

As part of the program of the wholesale-price reporting service of the Bureau, there has been adopted a revised method for computing the index number of wholesale commodity prices. The change in method was introduced with the calculation of the index for July 1937 and extended back to January. It is the customary weighted aggregate method with a fixed base and replaces the chain-index method of the aggregate type previously used. The procedure used is described in an article in this issue of the JOURNAL. Surveys have been completed for the improvement of the wholesale price reports for the cement and soap industries. The reports covering these two industries will be similar to the one issued for the farm-machinery industry and will give in detail the price data used in the calculation of the revised indexes, with brief discussion of the methods of computation. Other industries and important items being surveyed are lumber and millwork, brick, shoes and other leather products, automobile tires and other rubber products, chemicals, insulation and wall board, tile, fiber board, and small implements and tools.

UNITED STATES EMPLOYMENT SERVICE.—*Detailed Survey of Characteristics of Persons Seeking Work through the United States Employment Service.* A detailed survey of all persons actively registered during November as seeking jobs through the offices of the United States Employment Service is now being prepared. This survey, which will continue studies made through four similar inventories taken during the past two years, will furnish information concerning the occupational and industrial classification, age, sex, color, veteran classification, and geographical distribution of the active job-seekers. In addition, it is planned that the survey will indicate which of the registrants seeking work through the public employment offices in November were actively registered at the time of the July inventory survey. The present study coincides in timing with the voluntary census of unemployment.

Horizontal Classification of Jobs. Work on a preliminary horizontal classification of jobs in a number of industries has been started in an attempt to classify these jobs into groups or families of occupations. This horizontal classification is being made by grouping occupations on the basis of similarities of what the workers have to know, do, and be in order to perform their work satisfactorily. It is proposed to organize the information which has been and which is being collected regarding occupations and to study it carefully to find the degrees of similarity of occupations and some workable basis for classifying occupations on the basis of similarities of worker requirements.

CHILDREN'S BUREAU, U. S. DEPARTMENT OF LABOR.—Collection of schedules for the study of stillbirths undertaken by the Children's Bureau beginning February 1, 1936, was terminated May 31 of this year. A total of 6,750 schedules for this study have been received from 229 hospitals in 49 cities in 26 states and the District of Columbia. The tabulation of this material is well under way, and some preliminary findings have been released.

From an analysis of the data on the schedules certain basic information has been obtained with respect to color, age and parity of mothers, incidence of plural births, and sex of the stillborn infants. As was to be expected in a study of hospital cases, it was found that the mothers were slightly older and that there was a greater proportion of primiparae and of white mothers than is shown by census reports on stillbirths. Data in regard to sex of the stillborn infants and in regard to the incidence of plural births were, however, in close agreement with census figures.

The stillbirths were studied (1) in relation to whether the fetal death occurred before the onset of labor or during labor, (2) in relation to the period of gestation at which stillbirth occurred, (3) the method of delivery, and (4) the frequency of certain complications of pregnancy and labor and certain conditions in the infants.

In continuation of the reorganization of the Division of Statistical Research of the Children's Bureau, mentioned in the June issue of this JOURNAL, all units collecting recurrent statistical reports have been combined into a Current Statistics Section. Statistical reports now maintained currently by the Bureau include welfare statistics for large cities, collected in connection with the Bureau's Social Statistics Project, reports on employment certificates issued to minors, reports on delinquency cases handled by the Juvenile Courts, and reports on activities of the maternal and child-health and crippled children's programs conducted by the Bureau under the Social Security Act. The Current Statistics Section is in charge of Mr. Louis J. Owen, formerly State Coordinator of Statistical projects for the Illinois Works Progress Adminitsration.

WOMEN'S BUREAU, U. S. DEPARTMENT OF LABOR.—The Women's Bureau is conducting a number of surveys of women's wages and hours in states requesting such data for use as a basis in determining minimum wages. Field work is now in progress on such a study of Colorado, made in cooperation with the State Minimum-Wage Division and the report on a similar survey of Utah is nearing completion. In the State last named, 153 establishments were visited and pay-roll data taken for more than 5,000 women, the largest numbers being in stores and manufacturing plants, with appreciable numbers in laundries, hotels, and restaurants. Average weekly earnings of women in the various industries (excluding hotels and restaurants, where the cash wage is not always representative) ranged from $11.05 to $15.75, hourly from 25 to 37 cents.

A report on "Differences in the Earnings of Women and Men" is now in

press as Bulletin 152. The information presented is based on several field surveys, with supplementary material from other federal and state sources. The general levels of men's and women's wages are shown in various manufacturing, sales, and clerical occupations, and also the pay they receive for work of identical or essentially similar character. The data collected show that women's wages fall below men's with an almost uncanny uniformity in degree, regardless of changes in the general wage level, in business conditions, in source of labor supply, or other measurable factors, and for the most part this is true even where exact occupations can be compared witb reasonable accuracy.

A general survey entitled "Women in the Economy of the United States of America" is shortly to come from the press, containing a wide range of information from many sources, initiated by a request of the International Labour Office. This report includes data on women's occupational trends, wage status, unemployment, and responsibility for the support of others, and on the experience in this country as to the effects upon women of labor legislation applying especially to them.

Working with a committee of experts on budget requirements, the Women's Bureau has been working out a series of suggested essentials for the budget of an employed woman, which can be furnished to states for use in estimating cost of living prior to the establishment of a minimum wage, the items included to be priced locally within the state before making the estimate required.

OFFICE OF EDUCATION.—Reprints of the series of *School Life* articles on subject-registrations in public high schools are available. The annual study of "College Receipts and Expenditures," (1936–37) a sampling of about 300 institutions, and the annual "Statistics of Land-Grant Colleges" (1936–37) will be available from the Office of Education in November. The annual study "Per Capita Costs in City Schools" (1936–37) will go to the printing office in November.

In response to the request of the National Council of Chief State School Officers, the Office of Education has, during the past eighteen months, cooperated with the states in a program directed to such revisions of the respective systems of school records and reports as will be conducive to securing greater uniformity with consequent greater comparability of local and state school statistics. The field representatives of the Office of Education have personally conferred with the person or persons in charge of records and reports in the state departments of education. Findings from analyses made by this Office of certain basic record and report forms of the states were used as the basis of discussion at each of five regional conferences held last spring in Washington, D. C., Springfield, Ill., Salt Lake City, Utah, Montgomery, Ala., and Hartford, Conn. These conferences are reported as being of real assistance to the states in their efforts to make changes in record and report forms now in use.

The progress in this program has been made possible because of the active cooperation of the state departments of education, the National Advisory Committee on School Records and Reports, appointed by the Commissioner of Education, and other agencies interested in such records and pertinent educational data.

Statements and requests to this Office indicate that states are making certain revisions in forms used during the current year; others are to be made later. Indications now are that this cooperative program will probably be extended to cover at least another year.

BUREAU OF RESEARCH AND STATISTICS, SOCIAL SECURITY BOARD.—*Division of Public Assistance Statistics.* This Division has summarized recently the statistical data on public assistance for the fiscal year 1936–37 which will appear in the Annual Report of the Social Security Board. In addition to its collection of monthly reports on operations under the Social Security Act the Division has carried on its activity in the field of public welfare statistics.

General Relief Statistics: Complete data on general relief for 29 states and partial data for 18 states for the month of August 1937 were published in *Public Assistance, Monthly Statistics for the United States* on October 12. Continued field work by representatives of the Division is bringing to light many of the inconsistencies in State reports and is contributing gradually to the completeness and accuracy of the data. Revision of the publication policy of the Social Security Board has necessitated the elimination of the separate bulletin entitled *General Relief Statistics* but data on general relief are included in the *Social Security Bulletin*, formerly *Selected Current Statistics.*

Relief in Urban Areas: Reexamination of the relief data collected monthly from 116 urban areas since 1929 and addition of reports for the Civil Works Administration and the Works Program have delayed the monthly publication of *Relief in Urban Areas* since the May issue. Publication will be resumed with data which will present a more accurate statement of the trend of total relief for these important urban areas.

Relief in Rural Areas: The collection of relief statistics from selected rural counties was transferred from the Works Progress Administration to the Social Security Board on July 1, 1937. The Board's first issue of *Current Statistics of Relief in Rural and Town Areas*, for the month of July, will appear about October 28.

Total Relief in the United States: For the month of August 1937 the Board published in *Public Assistance, Monthly Statistics for the United States* two tables and one chart on all public relief programs in the United States. The monthly publication of these summary figures is continued in the *Social Security Bulletin.*

Social Data about Recipients of Public Assistance: Before September 1 all states participating under the Social Security Act had submitted their

annual reports of social data about recipients of public assistance for the fiscal year ended June 30, 1937. These reports covered a sample of 886 thousand persons to whom formal grants of public assistance had been made during a selected period of the fiscal year by state and local agencies administering public assistance under the Social Security Act. The total number of persons in households benefiting from grants in this selected sample was approximately 1,100,000 and the total number included in households receiving public assistance for June 1937 was slightly less than 2,000,000. The State reports have been summarized for inclusion in the Annual Report of the Social Security Board. A more complete report will be issued after January 1.

Divisions of Unemployment Compensation Research and Statistics. It is expected that by the close of 1937 all but three of the 51 states and territories will have installed the industrial classification code approved by the Social Security Board.

Data covering financial transactions have been reported since August, and coverage of workers, total wages subject to contributions, amount of contributions received, and other items have been reported by a majority of the states since October. These data are now reported as state-wide summaries. Beginning with the month of July 1938, all these items, with the exception of data on financial transactions, will be reported on an industry basis.

Monthly data on benefits will be reported by those states paying benefits beginning with January 1938. It is expected that reports will cover claims for benefits, promptness of benefit payments, the number of individuals for whom benefit checks were written, the number and amount of weekly benefit checks, and benefit terminations. The data on number of individuals for whom benefit checks were written and the number and amount of weekly benefit checks will be reported on an industry basis beginning with July 1938. The first reports, which will cover the first six months of 1938, will show the distribution of workers whose benefits were terminated, according to compensated weeks of unemployment, and the distribution of the amount of benefit payments and number of benefit checks according to benefit rates. Beginning with the month of July 1938, it is planned that data will be reported monthly showing the distribution of workers according to weeks of unemployment for which benefit checks were written.

Division of Old-Age Benefits Studies. It is expected that the data which result from the operation of the Old-Age Benefit titles of the Act will throw new light on questions concerning variations of wage rates between industries, regions, and types of communities, with respect to age groups and other characteristics of the covered population. Although the more important series which bear on wages and employment of the covered population will not be available for some time, there are already some figures which indicate the main characteristic of the major portion of industrial population of this country. Two large samples have already been compiled and are being analyzed. One of these comprises approximately 11½ million persons and results

from enumeration of employee applications for social security account numbers. This sample has already been analyzed to show age, sex, and race. The data have been tabulated by regions with various sub-classifications, and will eventually be shown on a state basis.

Some analysis of the claims already certified in connection with those covered persons who have reached 65 years of age or who have died prior to becoming 65 has been made, to see what wages are earned by such persons and to determine whether there is a large amount of migration in this group. These figures, although based so far on a very short period of observation, are preliminary to later studies which will show more significant results.

Probably the most valuable type of material which will come from the Old-Age Benefit provisions of the Act will be that bearing on quarterly, annual, and accumulated lifetime earnings. Indirectly this material will give some information with regard to certain aspects of employment, such as place, continuity, and industry, by age groups.

DIVISION OF SOCIAL RESEARCH, WORKS PROGRESS ADMINISTRATION.—*Separations Study.* A study of separations of workers from WPA employment in the period April through July 1937, similar to the separations study made last year, is being conducted in nine areas. The study is intended to determine the extent and character of private employment held by workers separated from the WPA, the characteristics of separated cases, and the amounts and sources of income received by such cases before and after separation.

Personal History Study. A detailed study of a small number of cases now in the field is designed to supplement the Division's statistical information with an intimate story of the people on relief, their reactions toward being unemployed, their attitudes toward relief, and their outlook for the future.

Survey of the Transient and Homeless Population. A re-survey of the transient problem has been conducted in six of the twelve cities studied in September 1935 and September 1936, covering the same points treated in the earlier studies.

Project Procedures. The Procedures Writing Section of the Division, which plans and prepares procedures for various local research projects, has recently prepared three procedures that should be of particular value to agencies interested in case work, housing, and allied problems. A technical circular, "Study of Resident Family Migration and Occupancy in Urban Areas," was prepared as a guide to the use of population materials contained in city directories. In addition to trends and rates of change of residence of families within the city, changes in occupancy of structures can be established. Technical circulars are also ready for two projects that will supplement the information secured from city directories: "A Central File of Basic Population Data" and "Index and Annotated Bibliography of Basic Social Data."

Sampling in the Field of Rural Relief. The Rural Section of the Division of Social Research has set up a county file of basic data. A card for each

county in the United States contains some twenty social and economic indices, such as type of agriculture, vital non-agricultural industries, population type, standards of living index, average farm income, and relief intensity. The file will provide a test of the representativeness of selected counties, determine the comparative homogeneity of the several areas, delineate sub-areas within major agricultural areas, and indicate the minimum number of sample counties that can be considered as a reliable sample of rural United States or of given areas.

Releases of the WPA Division of Social Research. "Part-Time Farming in the Southeast," Research Monograph IX, by R. H. Allen, L. S. Cottrell, Jr., W. W. Troxell, Harriet L. Herring, and A. D. Edwards, is a detailed study of the farming activities of 1,113 industrial workers in five major industrial areas of Alabama, Georgia, and South Carolina. It includes an appraisal of the possible efficacy of part-time farming as a means of improving living conditions and of increasing economic security.

In response to many requests for an early release of results of the cost-of-living study made in 59 cities, the Division has issued a preliminary report, "Intercity Differences in Costs of Living in March 1935, 59 Cities," by Margaret Loomis Stecker, who supervised the study and analyzed the data. A printed report including charts, tables, and budget data omitted in the present mimeographed edition will soon be released.

Other publications released are: *A survey of the transient and homeless population in 12 cities, Social service division staffs of the state Emergency Relief Administrations, 1935 and 1936* and *Relief and rehabilitation in the drought areas.*

DIVISION OF RESEARCH, STATISTICS AND RECORDS, WORKS PROGRESS ADMINISTRATION.—The Division of Research, Statistics and Records has recently prepared a catalogue of its publications.

An issue of the Report on Progress of the Works Program is being prepared for release at the end of the year. This report, like the last issue (June 1937), will present in broad perspective the operations of the Works Program with particular reference to the WPA activities.

Works Program Statistics. Particular interest at this time attaches to a report on physical accomplishment on WPA and NYA projects now in preparation. This is a summary of activities carried out on each project, covering work in progress as well as work completed, with over 200 types of project work listed on the report form. Such items as the following illustrate the varied kinds of accomplishments that are included: the number, the total square feet of floor and the total pupil capacity of schools built; the number and the capacity of storage tanks, reservoirs, and cisterns built; the number of classes in art instruction held and the number of different persons receiving such instruction, etc. Representing an extension and refinement of a similar report made as of September 15, 1936, the physical accomplishment report will, in the future, be filled out for all completed

projects as they are finished so that a periodic inventory of work can be obtained by securing current accomplishment reports for active projects alone.

A recent special study concerns the work carried out under the WPA Recreation Program. Forms have been filled out in the field for each recreation project worker. Among other things the survey covered the distribution of hours of work during a particular week in accordance with various types of recreation activities, kinds of recreational facilities used, and types of agencies making the recreation sites available. An analysis of the age of participants in the various recreational activities is also included. The study affords detailed information on this important program in each state.

The Division has recently published two reports prepared in the Section on Labor Research. The first, "Local Wage Rates for Selected Occupations in Public and Private Construction, 1936," presents extensive tabulations of hourly wage rates paid in public and private construction for 25 occupational groups during 1936. The data, which represent wage rates set by various Federal agencies as prevailing in each community and also rates paid in private industry, cover approximately 1,000 different localities in the United States. The second report, entitled "The Efficiency of Skilled Workers on Works Progress Administration Projects," presents the results of a study of the qualifications of workers assigned to the tasks of brick and stone masons, carpenters, and painters on WPA projects in January 1937. The study was carried on by the WPA with the cooperation of three international trade unions. It shows the results of an investigation of both the quality and quantity of work turned out by all WPA workers in the three crafts in the cities of Baltimore, Birmingham, Hartford, Memphis, Minneapolis, Scranton, and Toledo.

The revised report of the Construction Statistics Section covering public and private expenditures and employment in the construction industry has been published under the title "Construction Expenditures and Employment 1925–1936."

Relief Statistics. On the basis of optional reports submitted by State Emergency Relief Administrations detailed tabulations showing by types of project the number and cost of Emergency Work Relief Program projects have been prepared and published for 10 states. A preliminary summary for the Continental United States is nearing completion.

A revised statistical summary of emergency relief activities for the period January 1933 through December 1935 is being prepared. This bulletin will reflect revisions of figures published in the previous summary. It will also include additional data and more explanatory material.

In accordance with an agreement between the Social Security Board and the Works Progress Administration the monthly bulletin, *General Relief Statistics*, was issued as a joint publication of the two agencies for January, February and March 1937. Copies may be obtained from the Works Progress Administration.

A monthly memorandum on the various relief and work programs is being prepared for the administrative use of WPA officials. A basic objective is the explanation and interpretation of combined data on the Works Program, the National Youth Administration, The Civilian Conservation Corps, the public assistance program of the Social Security Board, general relief, and the rural rehabilitation program of the Farm Security Administration. The first issue "Relief in the Year Ending June 30, 1937" included a summary of statistics for these programs for the year, as well as data on changes during the current month. All issues have also included brief summaries for the United States of public expenditures for various types of relief since 1933.

National Research Project. The studies undertaken by the Project on "Reemployment Opportunities and Recent Changes in Industrial Techniques" have been outlined in previous numbers of this JOURNAL, which have also included a list of publications to June 1937. By October the following additional reports had been published: *The Research Program of the National Research Project; Mechanization Trends in Metal and Nonmetal Mining as Indicated by Sales of Underground Loading Equipment; Employment and Related Statistics of Mines and Quarries, 1935: Coal; Changes in Technology and Labor Requirements in Crop Production: Sugar Beets; Changes in Farm Power and Equipment: Mechanical Cotton Picker; Summary of Study on Labor Productivity in the Leather Industry* (in the *Monthly Labor Review*, July 1937); *Summary of Study on Mechanical Changes in the Cotton-Textile Industry, 1910 to 1936* (in the *Monthly Labor Review*, August 1937). A bibliography on farm practices and the use of labor on farms is in press.

Reports which are being prepared for publication include the following, *Employment and Unemployment Experience of Cigar Workers in Manchester, New Hampshire, Employment and Unemployment Experience of Coal Miners in West Virginia, Philadelphia Textile Workers—A Study in Irregular Employment and Its Social Consequences, Changes in Labor Productivity in the Manufacture of Beet Sugar, Changes in Job Requirements of Manufacturing Plants in Minnesota, Changes in Farm Power and Equipment: Farm Tractors, Changes in Technology and Labor Requirements in Crop Production: Corn,* and *Changes in Efficiency of Fuel Consumption in the Cement Industry.*

NATIONAL BUREAU OF ECONOMIC RESEARCH.—Four *Bulletins* have been published recently: Non-Farm Residential Construction, 1920–1936, by David L. Wickens and Ray R. Foster; National Income, 1919–1935, by Simon Kuznets; Technical Progress and Agricultural Depression, by Eugen Altschul and Frederick Strauss; Union Membership in England and the United States, by Leo Wolman.

The first volume of *Studies in Income,* containing papers presented at the 1936 annual meetings of the American Statistical and Economic Associations and at the January 1937 meeting of the Conference on Research in National Income and Wealth has also been published by the National Bureau. Two volumes by Simon Kuznets are in press: *National Income and Capital For-*

mation is a small monograph containing the summary figures, 1919–35; *Commodity Flow and Capital Formation* will contain the basic tables of the capital formation study together with a complete description of source materials.

Leo Wolman is on sabbatical leave from Columbia University to devote himself to writing a volume, for the National Bureau, on work and wages in the United States.

The Committee on Fiscal Policy, appointed in June by the National Bureau to further its cooperative program, has met twice. As soon as funds can be secured, a survey of material on the impact of the governmental fiscal system on the economy as a whole will be made with a view to laying out projects that should be undertaken to supplement the available data.

THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION.—The Station has just published Bulletin No. 309, "Recent Changes in the Social and Economic Status of North Carolina Farm Families," by C. Horace Hamilton, who is now with the Texas Agricultural Experiment Station. This bulletin is based on studies of approximately 3,500 rural families in seven North Carolina counties. General subjects covered by the bulletin are changes in farm tenure status, the agricultural ladder, changes in crop acreages and incomes, population composition and characteristics, trends in marriages, births, and migration, and trends in educational status. The above subjects are analyzed in relation to farm tenure and color.

Copies of the bulletin may be obtained free of charge from the North Carolina Agricultural Experiment Station, State College Station, Raleigh, North Carolina.

RESEARCH PROJECTS AT DUN & BRADSTREET, INC.—*The 1937 Retail Survey*, almost identical in form and coverage with the 1936 work, was completed in July, about six weeks earlier than was the case last year. It was based on operating statements received from 26,000 concerns, and covered somewhat over one hundred retail trades giving typical operating ratios such as gross margin, inventory turnover, expenses in detail and totals, operating profit, sales trends, inventory trends, and proportions of cash, credit and installment business. In those trades where the sample of reporting concerns was large enough to permit, additional breakdowns by size of store, size of town, and geographical territory were published.

The only significant change from last year's Survey was a refinement of the method of classifying concerns by trades. Many peculiar combinations are found involving in a single store what seem like two distinct lines of retail business. By obtaining the percentage of sales volume in each of the three major lines carried by any store, it was possible this year to classify each concern according to its major line, or if a considerable number of concerns reported the same combination of lines not dominated by any one group of commodities, a special combination trade was designated. The figures were tabulated separately as a group.

Most of the changes in expense and margin ratios between 1936 and 1937 experience were slight and were in the direction which would be expected as a result of increased prosperity and business volume. It is believed that an interesting statistical study could be made of the extent and character of these variations. This has not been possible because of the pressure of other work in the Dun & Bradstreet organization. The idea is suggested here for any interested explorer.

An Appraisal of the Undistributed Profits Tax. This study was the combined result of: (a) An impartial study of the form of the tax, based largely on government data, published comments and a careful weighing of the sources and natural bias of all material used, and (b) a special questionnaire mailed out to leading firms of certified public accountants and returned by over 700 corporations.

The statistical tables were mainly in the form of tallies of answers to specific questions. Frequency distributions were made of percentages given in answers to such questions as were framed to determine the proportion of earnings paid out in dividends before and after the tax. Two-way frequency distributions of some of these tallied answers were used to show trend of policy as influenced by the tax.

Surveys of Wholesalers' Operating Costs were released the third week in October for the following trades:

Name of trade	Number concerns reporting
Wholesale grocers	124
Automotive and equipment wholesalers	154
Dry goods wholesalers	72
Confectionery wholesalers	180
Bakers and confectioners supply houses	24
Floor covering wholesalers	30
Paint and varnish wholesalers	48

Each of the surveys was conducted in cooperation with a national association of wholesalers or manufacturers interested in that trade. The experience of the Department of Commerce as well as the Dun & Bradstreet office, plus the observations of practical business men suggested three basic propositions which were given special attention in planning the questionnaires and the tabulations:

(a) Inasmuch as the prevailing margins on different lines of goods vary widely within a single wholesale trade, differences in the major lines of goods featured by the several reporting wholesalers would cause variations in the annual operating margins and expense ratios.

(b) That it costs more to serve certain types of the wholesalers' customers than other types and, therefore, wholesalers who have developed a major bloc of sales volume among specific customer groups will be likely to record appropriate differences in their operating experience.

(c) In addition to the separation of profitable and losing concerns in such an analysis, those concerns earning less than a reasonable return on net

worth should be separated and studied as a "survival" group distinct from the "successful" group, earning enough return on their net worth to encourage the owners in the investment of additional capital.

Thus, wholesale grocers carrying a substantial quantity of perishable merchandise are analyzed separately. Automotive parts and accessories wholesalers selling primarily to retail accessory stores are distinguished from those doing most of their business with garages and service stations. The survival group of dry goods concerns attribute their small profit mainly to their failure to obtain an adequate margin, while the trouble with the losing concerns was almost entirely a matter of expense.

A Revised Insolvency Index computed back to 1887 will appear in the December issue of *Dun's Review*. The revision involved checking all known possible sources of inaccuracy in the original data, particularly a regrouping of figures which were reported in earlier years on periods of four or five weeks to conform to a calendar month basis. A seasonally adjusted series will be published parallel to the index.

THE PSYCHOMETRIC SOCIETY.—The Psychometric Society held its annual meeting on September 1, 1937, at Minneapolis, Minnesota, in conjunction with the American Psychological Association. A separate program of six papers on rational-quantitative psychology was presented.

At the annual business meeting presided over by President Edward Lee Thorndike, it was announced that Dr. J. P. Guilford of the University of Nebraska was elected President of the Society for 1937–38. Drs. Milton Metfessel of the University of Southern California and Karl F. Muenzinger of the University of Colorado were elected directors for the term 1937–38. At the dinner meeting held in Minnesota Union, Dr. E. L. Thorndike delivered the Presidential address, the title of which was "Psychometric Methods Applied to Sociological Data."

THE SOCIAL SCIENCE RESEARCH COUNCIL.—A series of research monographs on Social Aspects of the Depression has been prepared under the general guidance of the Committee on Social Aspects of the Depression under the chairmanship of Professor William F. Ogburn of the University of Chicago. Other members of the Committee are: Dr. Shelby M. Harrison of the Russell Sage Foundation and Professor Malcolm M. Willey of the University of Minnesota. Professor Samuel A. Stouffer of the University of Chicago served as Director of Studies.

These monographs were prepared by a number of authors, each of whom examined critically the literature on the impact of the depression in his field for the purpose of (1) locating existing data and interpretations already well-established, (2) discovering serious inadequacies in information, and (3) formulating research problems feasible for study. The purpose of the monographs was not to provide answers to any research questions but rather to formulate fruitful questions for research to suggest the kinds of data that are

available and the modes of attack which are most promising and otherwise to aid and stimulate research in this phase of social science.

The series includes *Crime* by Thorsten Sellin; *Education* by The Educational Policies Commission; *The Family* by Samuel A. Stouffer and Paul F. Lazarsfeld with the assistance of A. J. Jaffe; *Internal Migration* by Warren S. Thompson; *Minority Peoples* by Donald Young; *Social Aspects of Reading* by Douglas Waples; *Recreation* by Jesse F. Steiner; *Religion* by Samuel C. Kincheloe; *Rural Life* by Dwight Sanderson; *Social Aspects of Consumption* by Roland S. Vaile with the assistance of Helen G. Canoyer; *Social Aspects of Health* by Selwyn D. Collins and Clark Tibbitts; *Social Aspects of Relief Policies* by R. Clyde White and Mary K. White; and *Social Work* by F. Stuart Chapin and Stuart A. Queen.

The monographs are being distributed by the Social Science Research Council at one dollar each or ten dollars for the complete set.

CHAPTER ACTIVITIES

THE ALBANY CHAPTER.—The Albany Chapter held a dinner meeting on October 1, with F. J. Decker, President, in the chair. Forty-six members and guests were present. Dr. I. A. Hampt of the New York State Department of Civil Service, who was the principal speaker, gave a talk on the general purposes of job classification and salary scale standardization. C. C. Dubaur outlined the report of the Committee on Statistical Positions which was submitted to the Standardization Board.

Announcement was made of the nomination and election by the Executive Committee of Miss Mildred Lauder of the Department of Labor as Secretary of the Chapter. The action of the Executive Committee was confirmed by the membership.

THE CLEVELAND CHAPTER.—The first meeting of the Business Statistics Section of the Cleveland Chapter for the present season was held on September 27. The meeting was devoted to a forecast of the index of industrial production of the Board of Governors of the Federal Reserve System for the next twelve months. Ten members presented forecasts and each one attempted to justify his forecast. The composite was fairly optimistic since no one projected a major recession in industrial activity. The forecast for July 1938, ranged from a low of 108 to a high of 128. The low of the composite was reached in January at 109. No member projected the index below 99. Twenty members and guests were present.

Mr. L. M. Whittington of The Cleveland Trust Company was chosen as chairman and Mr. W. T. Diebold of The Ohio Bell Telephone Company was chosen as Secretary for the coming year. A note of thanks was expressed for the splendid work done by Mrs. Frida F. Selbert of The National Machine Tool Builders Association as Chairman during the past year.

THE NEW YORK DISTRICT CHAPTER.—A meeting of the New York District Chapter was held on Tuesday evening, September 28, at the Hotel Governor Clinton. The general topic for the evening was "The Outlook for Inflation, Business, and Security Prices." Donald R. Belcher, Assistant Chief Statistician of the American Telephone and Telegraph Company and a Vice-President of the American Statistical Association, presided. The addresses presented by three speakers are summarized in the following paragraphs.

The first speaker was Dr. Willard L. Thorp, Director of Economic Research, Dun and Bradstreet, Incorporated, who spoke on "Inventories as a Business Forecaster."

Business activity is the flow of goods, while inventories represent stoppages in this flow. They are particularly significant in that they focus attention on viscosity at various points along the economic process. A complete discussion of inventories would have to extend all the way from natural resources to goods in the hands of consumers. It should cover deferred serv-

ices which can be used only over a period of time, taking the form of consumers' durable goods, real property, or productive equipment. However, limiting the discussion to inventories at the more usual points, some idea of the scope of the problem can be obtained by rough estimates, as of the end of 1935, that manufacturing inventory was about $9.7 billions; wholesalers' inventory, about $2.5 billions; and retailers' inventory, $4.3 billions; a total of $16.5 billions. However, it should be noted that manufacturing inventory is made up largely of goods in the process of production, so the total finished goods' inventory would probably be nearer $10 billions.

The importance of inventories in the economic picture varies tremendously from industry to industry. One indicator of this importance is the turn-over rate, which is a way of measuring the length of time it would take to liquidate the inventories on hand. Furthermore, an examination of certain specific retail trades shows that changes in inventories are not uniform but may vary according to size groups within the trade. During 1936, for example, the furniture trade showed greatest inventory increases in the largest stores, while the women's ready-to-wear trade showed them in the smallest.

In judging changes in inventories it must be remembered that certain variations are almost automatic, arising from such causes as changing sales volume, seasonal fluctuations, or the lag required before production schedules can be changed. In addition to these considerations, there is an extremely close relationship between inventories and prices, the two tending to advance or decline together. Also, inventory changes are dependent upon the current state of psychology, since that inevitably involves the creation or deflation of commodity speculation in inventory form. Not only are inventories the result of other economic factors, but they in turn can have an important effect upon the volume of production and the behavior of prices.

At the present time, the data available for judging inventories are extremely scanty. Nevertheless, taking the data from many sources, it appears that increases in inventories in 1935 and in 1936 were in general less than increases in sales. During 1937 there has been increasing talk about high inventories, largely the result of the nature of the statistical evidence. In 1936 the great increase in inventories came in the last few months of the year. Although inventories in 1937 seem to have reached their peak about March, they still show a high percentage gained over a year ago, because of the low state of inventories in the early months of 1936. At the present time inventories seem to have about their normal relationship to sales and the forgotten point is that in the summer of 1936 they were extraordinarily low. In fact, this low inventory condition contributed greatly to the boom of the late months in the year.

Professor O. M. W. Sprague of Harvard University spoke on "Why Inflation is Not Imminent."[1] We have not had inflation yet, if we mean by inflation a rapid and extreme advance in commodity prices. The advances since

[1] Professor Sprague's address was printed in the *Annalist* for October 8, 1937.

1932 are those which always accompany recovery following extreme depression. Although extraordinary increases in monetary gold will eventually increase prices, the mere increase is not sufficient unless the gold is inadequate at the time of increase. With adequate gold, further increases remain dormant until there is intense demand for additional currency and credit, taking the form of expanding bank loans and investments.

Easy money policies have not been sufficient to induce a generally large increase in demand for bank credit. The government has been the only large-scale borrower, but its borrowings and deficits have not been sufficiently great to produce price advances. Government credit has been strong, and therefore there has been no flight from money into commodities, creating "fear" inflation. The possibility of such "fear" inflation is remote. If there is to be inflation, it must result from an intense demand for all sorts of labor and materials, supported by rapidly expanding bank loans. This cannot be produced by increasing the purchasing power of consumers with small incomes. Since people save money and seek to invest it, there must be commensurate capital investment if there is to be widespread demand for materials and labor. Approximately three-quarters of capital investment, directly or indirectly, goes into construction. Capital investment has been small, despite easy money, largely because construction costs are high. Construction now costs 15 or 20 per cent more than it did two years ago. Costs have advanced well before capacity production in construction has developed, rather than as a result of intense demand. These increased costs seem to be the principal obstacle to more active business with the attendant but distant danger of inflation.

In Great Britain an easy money policy and lower construction costs resulted in a vast increase in employment mainly in the construction of houses. In the recovery Great Britain got something of enormous value to the mass of the people.

Business recovery depends upon business pricing policies more than upon Washington's policies. The most effective lifting of living standards is through reduction in prices of things having elastic demand. In Great Britain brick prices were reduced three times between 1932 and 1935. In this country they have advanced, but nobody maintains that demand for them is in excess of brickmaking capacity.

Hasty price increases are inappropriate to situations where there are technological improvements. Such improvements produce unemployment, unless prices be lowered and outputs increased. So long as prices are maintained by advertising or otherwise, there is no danger of inflation, but there is also little likelihood of attaining maximum production and full employment. Greater inflation danger is preferable since that can be controlled, but it is questionable that a democratic country can successfully handle chronic unemployment. Chronic unemployment, resulting from rigidity of prices, prevailed before this Administration came into power. At that time it was said reduction in construction costs would not induce a demand. During the

past two years, however, such reductions would have increased demand. Instead of reductions there have been increases. Government appropriations for housing, unless administered so as to reduce unit costs, will help only those people fortunate enough to secure places in the houses the Government assists in building. Both Washington and business need to see the advantage of reducing prices where there are many technological improvements, and where there is an elastic demand. Under the circumstances, I feel very confident that inflation is not imminent.

James F. Hughes, Market Analyst, Charles D. Barney and Company, discussed "The Future of Security Prices."[2] Sometime between now and February, 1938, there will be a fair intermediate recovery in stock prices. The period between now and then is considered exactly analogous to the period from October, 1923, to the spring of 1924.

Beyond the Spring of 1938 there are three possibilities which might be termed, "The Tragic Retribution of Economic Justice," "The Compromise of Practical Politics," and "Realistic Economic Statesmanship." Under the first possibility market prices will continue downward the greater part of 1938 as a result of a continued deflation in bank credit. This could come about through a liquidation of the swollen investments of banks largely in government bonds. From 1933 to 1936 investments of all banks increased $10 billions—deposits increased $16 billions, but bank capital only increased $600 million. This most rapid of all increases in deposits and investment in connection with small increases in capital assets resulted, in 1936, in the highest ratio of deposits to capital ever reached. Despite this serious capital problem the monetary managers proceeded to increase by one hundred per cent the reserve requirements of member banks in order to prevent astronomical loans to a business, a policy analogous to that of 1923 and 1924. This not only checked the expansion of credit, but brought about a contraction in credit. In the presence of other discouraging factors, it seems unlikely that it will be easy to reverse the downward trend in industrial activity, commodity prices, and security prices.

The commodity price situation furnishes an even more direct analogy between 1923 and 1937, and it is believed that commodity prices, as they did in 1924, will continue to sag off in 1938. Perturbation on the part of our monetary managers, especially if the Federal Reserve Board index of production begins to flirt with one hundred next spring, raises the question whether something analogous to the handsprings of the monetary managers in 1924 will then take place.

In connection with the "Compromise of Practical Politics," a *Wall Street Journal* article may be noted: "A renewal of government spending on an emergency scale to stimulate fall and winter business activities will be urged on President Roosevelt. . . . " In the same connection Mr. Morgenthau said: "In line with talks I had with the President . . . we are looking in

[2] A stenographic account of Mr. Hughes' talk was printed in the *Annalist* for October 8, 1937.

every direction to see where we can save money for this fiscal year." Apparently a choice has to be made before next summer.

The third possibility is a starry-eyed idealist's dream, "Realistic Economic Statesmanship." This involves restoration of the balance between business and finance which prevailed before the advent of scientific credit management. When this balance existed, most of the "bull" markets occurred when business was below normal, and "bear" markets occurred when business was above statistical normal. Panics and little "bear" markets normally were completed before business became depressed. A new era like that we had in 1929 never occurred before the days of scientific credit management. It is suggested that our managers try to restore the old-fashioned balance. When business is below normal speculation might be encouraged. Certainly the creation of new capital for corporations should be encouraged. During the past five years new corporate capital raised has amounted to $3 billions, as compared with $28 billions in the five years ending in 1929. We certainly need more now than $3 billions. If it is not obtained, there will be a slow drift towards inflation. We have been drifting that way for five years with no realistic concept of what makes prosperity or depression.

In 1938 we will be struggling with problems involving business activity, commodity prices and the stock market. My guess is that we will do so on a policy of political compromise.

THE PITTSBURGH CHAPTER.—On September 30 the Pittsburgh Chapter joined with the Pittsburgh Personnel Association to hear Mr. Andrew Fraser, Jr., of the Bureau of Labor Statistics, United States Department of Labor, speak on, "A Survey of the Engineering Profession." There were fifty members present.

At a meeting of the Chapter on October 28, Mr. Bervard Nichols, Editor of the *Pittsburgh Business Review*, led a discussion on the general business situation. The discussion was participated in by the following named men who told primarily the effect of the present business conditions on their particular line of work: Mr. G. A. Doyle, Bell Telephone Company; Mr. Charles A. Carpenter, U. S. Department of Commerce; Mr. E. C. Stone, Philadelphia Company; Mr. D. H. Bulter, Economic Statistics, Inc. The meeting was very interesting, with an attendance of 36.

At this meeting the following officers were elected for the coming year: President, William R. Hamilton, West Penn Power Company; Vice-President, Frank M. Kenney, Duquesne Light Company; and Secretary-Treasurer, Ralph Fletcher, Bureau of Social Research.

THE SAN FRANCISCO CHAPTER.—At the meeting on July 22, 1937, Professor W. L. Crum of Harvard University addressed the Chapter on "The Current Situation in American Business." A summary of Dr. Crum's address follows.

The present situation in business is so complex that a brief talk can do scarcely more than present a cross section of the current picture. Forecasting

and prognostication are not only unwise but most difficult in view of the existing circumstances.

There are certain peculiarities in the present situation which are very important to a statistician in interpreting trends and current levels, peculiarities which are for the most part new developments or at least appear in new forms. One of the leading problems confronting the business statistician is the labor situation. Labor disturbances are customarily incident to the early stages of a cyclical business revival, and the increased frequency of labor disturbances is qualitatively nothing new. But certain important characteristics of this labor struggle are obviously different from those we have seen before, and labor objectives are of a different sort than they have been in the past. Labor objectives have now almost a political character. We have now a development of labor power capable of being mobilized and directed like an army. This is indeed new. For the first time in many years labor has found an extremely forceful leadership; showing a capacity for a kind of drive unknown heretofore in the labor movement. Again, the suspicion prevails that the present labor drive is in some way allied with one of the political powers in the nation. These differentiating characteristics have made recent developments in labor more ominous to business management than would otherwise have been the case. Normally strikes are a natural attendant of a period of recovery following a depression, but this situation is peculiarly threatening.

The fact of a fundamentally altered currency and credit situation also distinguishes the current economic set-up. It is not inaccurate to state that never before have we had a converging of such worries as the gold problem, the possibility of more complete central bank control, and the extensive participation of the government in economic affairs. We have gold importations the magnitude of which is entirely unprecedented, the clearly formulated makings of credit management, a central bank in a truer sense than heretofore, and certainly the participation of the government in credit management on an unheard-of scale. Therefore, a new situation in credit exists which is quite beyond the reach of mere analogy with the past.

Another basic distinction between the present and the recent past is the greatly broadened activity of the government with respect to industry and finance. This recovery is a recovery under the auspices of governmental regulation on a grand scale, a governmental regulation marked by the appearance of opportunism apparently devoid of a broad outline of the kind of structure toward which it is aiming. There is some justification for the belief in certain quarters that such an outline has never existed. There is no announced and clarified philosophy of the relation of government to business. This appearance of opportunism has been one of the most disquieting threats to business management. Business can adjust itself to changed conditions, but change which is taking place spasmodically is in the highest degree disquieting to policy-forming management. This is one reason for the reluctance on the part of executives to plunge into commitments running far into the future.

The statistician who interprets the record must remember that we have very imperfect machinery with which to arrive at conclusions. We are utilizing a lame set of analogies with the past; and actuating our logical processes is the thought that the current situation resembles another, say thirty or forty years ago, and that findings concerning history give an answer to the present. There is such a thing as the unfolding of a cyclical development, but we are not now in the course of a normally unfolding business cycle, and have not been since the War. It is practically impossible to superimpose upon the current situation some earlier chunk of economic history and get a significant fit. Because the new factors are so important, we must use past analyses with a great deal of reservation and doubt.

We find frequent assertions in the financial press that business is far above normal. As a matter of fact we have no scientific basis for ascertaining what is normal, we have had no such basis since the War; and there definitely is no warrant for determining the normal by statistical methods. Another problem presents itself in the study of price movements, their classifications and bases of reference. We have classified commodities on various bases; by nature of the raw material, by manner of use, by place in the industrial world (whether they move in world trade), and by price making characteristics. Again, in the case of banking statistics, we have an instance of a new statistical difficulty in the recent re-classification of loans by the Federal Reserve Board. Loans have in the past been classified broadly on the basis of nature of the security, now they are classified according to the purpose for which the money was loaned. This is a good change, a change which could helpfully have been made twenty years ago; but, made recently, it obstructs current analysis. Likewise seasonal indices, because of changed ideas with regard to seasonal movements, are statistical tools which are rapidly becoming obsolete. Hence, some of the very factors which distinguish the current economic situation operate to destroy the aptness of our methods.

A somewhat easy interpretation of the present picture is that we are entering upon an era of general credit inflation, that numerous steps have been taken to induce such an experience; and that what has happened in security and commodity prices, expansion of bank credit for building, etc., are manifestations of an incipient inflation. We cannot prove that this is a wrong interpretation and certainly it is a possible one which no serious student can conscientiously overlook. However, making such use as we dare of past analysis, all that has happened *can* be interpreted as a fairly normal cyclical revival of the ordinary sort. The whole movement of business activity during recovery can be interpreted as a cyclical revival which has progressed perhaps half way along its route.

LEROY D. PEAVEY

Leroy D. Peavey, for fourteen years a member of the American Statistical Association and for two years (1931 and 1932) President of the Boston Chapter, died at his home in Watertown, Massachusetts, on March 25, 1937.

Mr. Peavey was born in Exeter, New Hampshire, on March 11, 1876. After graduating from Phillips-Exeter Academy, he attended Massachusetts Institute of Technology, from which he received the civil engineering degree in 1898. He secured a position with the Converse Engineering Company and remained with that company until 1910, when he became connected with the Babson Statistical Organization. Shortly afterward, he was appointed Business Manager and Vice-President of that organization, and in 1925 he became its President. He was a member of the American Economic Association and of the Executives Club of Boston and addressed many business organizations in the principal financial centers of the country. In addition to his statistical and business interests, he was an active church worker. He was a member of the General Board of the Church of the Nazarene and was Treasurer of Eastern Nazarene College for several years. His wife, one son and four daughters survive him.

ROSWELL F. PHELPS

NEW MEMBERS

Baumann, George A., Supervisor, Bureau of the Census, Department of Commerce, Washington, D. C.

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Grover, Dr. Morris L., Chief, Bureau of Preventable Diseases, State Department of Public Health, Room 329, State Office Building, Providence, Rhode Island

Hilleboe, Dr. Herman E., Director, Divisions of Tuberculosis and Services for Crippled Children, State Board of Control, 239 State Office Building, Saint Paul, Minnesota

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Turner, Dr. Robert C., Instructor in Economics, College of Liberal Arts, Wayne University, Detroit, Michigan

Vivó, Ing. Hugo, Jefe de la Oficina de Numeros Indices, Secretaria de Agricultura, Habana, Cuba

Williams, Frederick, S. H. and Lee J. Wolfe, Consulting Actuaries, Auditors and Accountants, 116 John Street, New York City

Wright, William Webb, Marcy State Hospital, Marcy, New York

Yane, Boris S., Under-Assistant Economist, Department of Labor, 705 Albee Building, Washington, D. C.

REVIEWS

L'Equilibre dans les Relations Economiques Internationales, by Albert Aftalion. Paris: Les Editions Domat-Montchrestien. F. Loviton et Cie. 1937. 466 pp. 60 fr. Printed in French.

This volume consists of five parts in addition to an introduction and a conclusion. The first part is a critical analysis of the various theories of automatic equilibrium. The other four are a statement of positive theory, dealing successively with reequilibrium of the balance of accounts, movements of capital and movements of merchandise, equilibrium of the balance of payments, and world equilibrium of prices. The analysis is detailed, and there are unnecessary repetitions of ideas, owing apparently to the author's anxiety that under every point raised no step in the argument shall be omitted.

In the introduction, which discusses the different concepts of balance, Professor Aftalion is confronted with difficulties of terminology. The idea of the commercial balance or balance of trade is a common one and sufficiently precise for his purpose. But he wishes to draw a distinction between two other ideas for which there are no commonly accepted terms. He does it by discriminating between the balance of acounts and the balance of payments. The former sets forth the economic relations of a given country with the rest of the world for a given period, usually a year. It includes the visible and invisible items with which economists are familiar and is seldom, if ever, in strict equilibrium. There is regularly an excess or a deficit.

"Balance of payments" is a broader term, embracing everything included in the balance of accounts but also all movements of capital and of gold which do not appear in the balance of accounts, especially those which show the existence of creditor or debtor status in the balance of accounts, making necessary or indicating new capital investments. Except in cases of insolvency, the balance of payments is normally in equilibrium.

This distinction is a valuable one and runs throughout the volume. There is, in fact, as Aftalion shows, no reason for expecting equilibrium in the balance of accounts, even over an extended period of time. If the concept includes new loans and advances of all sorts, including open book accounts, short-term bills, etc., the fact of a balance is a truism. If, however, new loans and advances of all sorts are excluded, there is no reason to expect a balance, and the excess or deficit may, as he points out, continue for an indefinitely long time. The terminology is, as he realizes, awkward but the distinction is important. Although equilibrium in the balance of payments is not a reality at all times, it is nevertheless the norm toward which the economic world necessarily tends. As disequilibrium appears it sets in motion reactions which automatically bring a reequilibrium. To explain this is the purpose of the volume.

The older and the usually accepted theories of automatic equilibrium in

the balance of accounts are examined and criticized as inadequate—barter, gold movements, capital movements, the rate of discount, fluctuations of the exchanges. In every case they show theoretical defects, and, besides, the balance of accounts regularly shows an excess or a deficit. There is some tendency toward equilibrium, but when it occurs the older explanations are inadequate.

Professor Aftalion's objections to many of the usual views are due to his dissatisfaction with the quantity theory of money. His own preference is for his formula $R = PQ$ in which R is income, Q is commodities and services produced, and P is the average price. Instead of finding the stimulus to change immediately in P he finds it in R or in Q. "The stimulus arises from the inequality between income or available resources and production due to the disequilibrium in the balance" (p. 449). A deficit in this balance implies a reduction in income as compared with production which reduces the capacity of the domestic market to absorb this production and leads to an increase of exports. An excess of available income over production correspondingly encourages an increase of imports. These forces, however, encounter many psychological, political, and economic factors which condition their appearance and their efficacy. When disequilibrium appears in the balance of accounts, there is no certainty that an equilibrium will be established, but merely a possibility. Deficits or excesses are persistent even over long periods of time. There is a tendency toward a world equilibrium of price, but it is due not to movements of gold or of capital and not entirely to the sale of merchandise but to other factors also, especially to the psychological. Again there is only a tendency toward an equilibrium but no certainty that it will be realized.

Since automatic influences cannot be relied upon for the maintenance or restoration of equilibrium, direction is needed in the form of intervention by the State. State policies have, in fact, been primary causes of the appearance of disequilibrium, but it is not the principle of intervention that is at fault. It is its application that has been dangerous.

Several comments may be made. Professor Aftalion has rendered a distinct service through his emphasis on the distinction between the balance of accounts and the balance of payments. Harm has been done by the careless and inaccurate contention that imports must equal exports, even when the statement is qualified by the inclusion of invisible items and references to "the long run."

Although the quantity theory of money is currently in disfavor, Professor Aftalion's analysis does not adequately dispose of it, except perhaps in its crudest form. He substitutes his favorite formula—$R = PQ$—but does not make clear just how an inequality between R and P arises. Further argument is needed to show how this inequality arises, and unregenerate adherents of the quantity theory would locate the cause on the money side of the price ratio.

Finally, it should be said that the author has rendered a further service

by emphasizing the weaknesses in many theories, in stressing political and psychological as well as economic factors, and in reminding us so forcefully of the facts, including the errors, of state intervention.

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Balances of Payments 1935. Geneva: League of Nations. New York: Columbia University Press (Agents). 1937. 176 pp. $1.50.

This volume is one of the League's series on balances of international payments which have appeared annually for more than 15 years. The present issue reprints the figures compiled by 28 countries, colonies, or other areas. The corresponding number a few years ago was more than 40. There are, nevertheless, a few countries which are relative newcomers: Russia, China, Palestine, and Curaçao.

Prominent among the countries formerly reporting but not included in this symposium for 1935 are Italy, Switzerland, and Belgium; and none of the 21 Latin American Republics, of which several formerly compiled balances of payments, is now included. Though Italy's defection has a special explanation, world-wide hard times may explain the reduced number of these expensive studies. When budgets pinch, why disburse for statistics not really understood by some of the compilers themselves and ignored by the framers of international policy everywhere?

This review is made from the standpoint of methodology. Which countries are refining their estimating methods, extending the scope of their investigations, and revising their figures for earlier years? Which are discovering new invisibles? Which are "completing their stubs"—boldly entering into the prose of their tables every invisible item known to exist, however poetic the arithmetical measurement opposite it? Which are estimating by subclasses of transactions for each item: Dividing to Conquer? In brief, which countries just now are doing the balance-of-payments thinking for the rest of the world?

The Netherlands lead in the space accorded by the League editors, and none of the space is carelessly filled. There is a balance of payments for the mother country and one each for Netherland Indies, Surinam, and Curaçao; besides, there is an "inter-area" table of payments between Netherland Indies and the mother country (pp. 120–22). The Netherland stub includes such relatively new items as adjustments for diamonds, for fishery products bought from foreign vessels, and for gold sent by post. Capital transactions are broken into 14 subclasses; earmarking of gold, into 7. Yet, "owing to the incompleteness of the information available, no totals are shown" (p. 114). Where there is such evidence of integrity in compiling, it is likely that the international turnover (credit footing, plus debit footing) is within one-twentieth of unknowable absolute accuracy. Both the totals and the discrepancy due to errors should have been shown—for any of six reasons that could be cited.

France, whose Foreign Office is said "never to learn anything and never to forget anything," still dispenses with official balances of payments. The League editors printed, for France, the private study by Leonard Rist and Philippe Schwob (pp. 82–7). This scholarly study undoubtedly benefited from the admirable pioneer work of Pierre Meynial, private compiler for France for a decade or so; but the new compilers courageously adopted a longer stub more finely subdivided. An interesting feature of their own pioneering is the extending of their balance-of-payments area to encircle France and her oversea territories. Definitely, they have gone Meynial "one better."

Canada, also, may merit the highest praise. Under Dominion Statistician R. H. Coats, a trio of keen, well-trained scholars have patiently continued their investigations, repeatedly extended, constantly revised. They have in manuscript an exceedingly laborious report on balances of payments between Canada and the United States for a long series of years; this inter-area study will record the heaviest volumes of transactions between any two countries in the world.

The Latvian compiler should be watched appreciatively. His stub includes the sawing of Russian and Polish wood in transit; also, salaries of Latvian journalists and artists living abroad (two items). He has set an example for the compilers of larger areas. In my "International Transactions" I argued that compilers should build dossiers on "miniature invisibles" or miniature adjustments of large items. These tiny groups of transactions may suddenly expand to balance-of-payments dimensions and thus reward scrutiny.

For stagnant technique we might turn to the United Kingdom (pp. 149–55). Its balance of payments for 1935 appeared in the *Board of Trade Journal* for February 20, 1936; no time no effort. The nation which originated balances of payments was still able to wag along with its traditional stub of a Big Six or Big Eight items. One of these items, "net receipts from other sources" includes: receipts and outgoings on account of the sale and purchase of second-hand ships to and from other countries, emigrants' remittances, the savings of emigrants returning to the country, tourists' expenditure, diplomatic expenditure, etc.

A major handicap of balance-of-payments science may well be that its output is edited at Geneva each year by Englishmen. Like the compilers for the United Kingdom, they view their work as something static. Their earlier annual volumes necessitated some slight originality in presentation, since unchanged. Next year's volume could be made as vital as last year's, by a newspaper hack or bookkeeper. The editors take the sentient findings of dozens of compilers the world over and fit them all into the League's long preconceived report form; although there is nothing more uncertain in this growing science than how best to present its findings. The objective of the League's premature stereotyping was, of course, comparability, however specious; but the effect smacks of taxidermy.

The League would do better by reprinting the balance-of-payments tables of the various countries, just as they were originally presented—no individuality or local color lost. This would not prevent the League's drawing from them comparable data for its special tables on capital and tourist movements and for what it calls its "synoptical" table (p. 9).

The League editors fall far short of their opportunities to improve balance-of-payments work all over the world. (1) They should feature in their preface the year's discoveries of new invisibles, refinements in estimating, or novelties in analysis, interpretation, and presentation. The mere citing of the individual compilers who originated them would be a stimulus to further creative thinking; but the best of the new ideas, thus featured, might faster be adopted by other countries. (2) Anonymity is a stifling thing, bad in journalism and worse in scholarship. Realizing that balances of payments are necessarily about as individualistic as oil paintings, the editors should give both names and addresses of the compilers for each country. This would sharpen the professional pride of compilers everywhere; further, it would facilitate technical correspondence between compilers. (3) The alphabetical listing of countries should be broken into two or perhaps three alphabetical listings, depending upon the completeness of stubs. This rough grading by quality would become a stimulus to the numerous third-rate compilers to work themselves out of their present class.

There are some minor defects in this volume. Failure to indicate the foreign-currency equivalent of a money like the Siamese baht is one. Deadness of style, so often associated with stagnancy of thought, is another. "Total amount," used many times, is worse than dead; and so is "in that connection it might be interesting to note that" (p. 21). English editors may be pardoned for supposing that a billion is a million millions and adopting "milliard," but American readers can likewise be pardoned a condescending amusement.

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National Income and Outlay, by Colin Clark. London: Macmillan and Company, Ltd., 1937. xix, 304 pp. $4.50.

In Mr. Clark's opinion, with which the reviewer concurs, studies of national income and outlay constitute the most fertile and most important segment of the entire field of statistical studies related to economics. This is because nearly all the propositions of economic science are concerned with statements about the national income, and the whole purpose of economic study is to discover methods which will (1) increase the average national dividend, (2) regularize its flow through time, and (3) equalize its distribution among persons.

This conception of the significance of national income measurements permeates *National Income and Outlay*. The topics treated by Mr. Clark and

the conclusions which he draws from his estimates are designed, by showing what the facts are and how they have come to be what they are, to aid in attaining the threefold objective of economic study. The phases of national income and outlay which Mr. Clark covers include the amount of the national income each year 1924–35, its primary distribution among factors of production and among persons and its redistribution through taxation, its utilization for consumption and for investment, adjustment for price changes and the amount of "real income," quarterly indexes of national income adjusted for seasonal variations, comparison of the national income in 1934 with that in 1688, sources of the national income, changes in consumption and in investment during the 1929-36 cycle, capital accumulation and its relation to the national income, and, finally, the rate of economic progress as indicated by long-term trends in income per capita.

After stating that the *national dividend* (a term which is used interchangeably with *national income*) must always be conceived in real, but measured in money terms, Mr. Clark defines the national dividend as follows:

> The national dividend may be defined for any period as those goods and services which flow into being during that period which are customarily exchanged for money, avoiding, of course, double reckoning of those goods and services which are produced at one stage but then used up again in another stage of the productive process. We require a net total of the value of goods and services available for consumption or investment.

This definition is virtually identical with definitions given by King, Kuznets, Leven, and other American writers on national income. Mr. Clark interprets the definition, however, to include an evaluation of one important class of services which has been uniformly excluded by national income investigators in the United States. This item is the cost of services supplied free by government. Mr. Clark defends the inclusion of the value of governmental services as follows:

> Modern economists in every case now include the value of such services in the national dividend. It is clearly absurd that the services provided by a school or a water-system should be reckoned as part of the national dividend if they are run as commercial concerns, but should cease to be so reckoned if they are taken over by the State or municipality.
>
> . . . Of the services provided by public enterprise, those which are sold in the market (e.g. postal services, municipal trading services) will similarly be reckoned in at the prices at which they are actually sold; others, such as public health services or free education, must be reckoned in at cost price . . .
>
> These distinctions are not a mere pedantic necessity, for in many communities a substantial proportion of the national dividend is provided by communal enterprise.
>
> Returning to our criterion of "customary exchangeability," we may reasonably regard services rendered by public authorities as exchangeable for money, either in the form of rates or taxes, or directly.

Mr. Clark also includes in the national dividend the rental value of houses

occupied by their owners but makes no allowance for imputed income from other types of goods owned and directly used by consumers. He states:

> The utility which a private individual derives from his own stock of goods, clothes, furniture, crockery, motor-car and the like, is not customarily exchangeable for money. On the other hand, the leasing of houses is certainly a customary form of exchange, and if a man occupies a house which he himself owns, we should regard the annual value of the house, as indeed do the British income-tax authorities, as part of his income. By the same token we must define dwelling-houses as capital in that they will produce real income or dividend in the future, while denying the appellation of capital to private motor-cars, furniture and the like.

Four methods of measuring various components of the national income are utilized by Mr. Clark: incomes received by individuals or on their behalf by business enterprises and governments; incomes paid out by types; net value of output of the major divisions of the economy; and expenditures upon consumption and capital expansion. His chief estimate of the amount of the national income, covering each year of the period (1924–33) with preliminary estimates for 1934 and 1935), is based for the most part upon incomes received by individuals, inserting, however, the net product of agriculture as the income of persons engaged in agriculture. The components of this basic estimate are as follows:

> Incomes subject to income tax assessment, including incomes of persons, incomes of charitable and similar organizations, and undistributed profits of joint-stock companies;
>
> Incomes of wage-earners, obtained in part from census statistics and in part from estimates of the number of wage-earners and of average annual earnings;
>
> Agricultural income, taken as the net value of output of agriculture, deducting wages of agricultural workers;
>
> Earned and property income of persons not wage-earners or farmers and not subject to income-tax assessment, earned income being estimated from the numbers and average annual earnings of salaried persons and of independent workers, respectively;
>
> Governmental income from services sold, net balance of inter-governmental transactions, and indirect taxes, deducting interest on the internal national debt;
>
> Maintenance and depreciation allowances of business concerns (included in gross but excluded from net national income); and
>
> Income due to foreigners, to be deducted.

The chief difference between this method and that followed by the National Bureau of Economic Research and the Department of Commerce in estimating national income in the United States lies in the inclusion of governmental revenues. This is made necessary by the inclusion, in the definition of the national dividend, of the cost of governmental services supplied free to the public. Mr. Clark comments as follows on the effect of this procedure in estimating the amount of the national income.

> At first sight it seems absurd that a Government, by increasing indirect taxation, should be able to increase the national income. But we must reflect that the effect of all indirect taxation is calculated to be a corresponding rise in the price of the articles or services taxed. Real national income is calculated by dividing the money national income by an appropriate price index, and this price index is bound to incorporate the effects of changes in national and local indirect taxation. Looking at it another way, the State and local authorities may be regarded as entering into certain trades as a gigantic monopolist, and the price of goods to the consumer is enhanced thereby. If a private company obtain a monopoly of any commodity and make big profits on it, we include these profits in the national income, pointing out, however, the high price of the commodity in question when we come to consider the effect of the monopolist's action on real income. Exactly the same treatment can logically be applied to the revenue drawn by the State and local authorities from indirect taxation.

The probability that a portion of governmental revenues from taxes other than income taxes is not passed on to consumers in the form of higher prices but results in a diminished money income of company stockholders, individual business proprietors and owners of rented property, and thus represents a direct transfer of income from individuals as such to the government as a collective agent for the people of the nation, is not mentioned by Mr. Clark. This, in the reviewer's opinion, is an additional important reason for treating the problem of governmental revenues by Mr. Clark's method rather than by the method used in the United States.

Even Mr. Clark, however, is not completely consistent in his treatment of governmental revenues and expenditures. He takes them into his calculations in his basic estimate of the total national dividend and also in an analysis of the distribution of the product of industry among factors of production and of its partial redistribution through taxation. On the other hand, in an analysis of the national outlay for consumptive purposes in 1932 he deducts indirect taxation incorporated in selling values—a procedure which departs from the point of view described in the quotation above comparing price advances due to indirect taxation with those due to monopolistic action. He also omits indirect taxation when calculating the net value of output of the major divisions of the economy in 1911, 1924, 1930, and 1934. Consistency with the procedure in the basic estimate requires that indirect taxes be considered a part of the net value of the product of the industry on which they are imposed. If Mr. Clark's analogy of a monopolist is carried a little farther, the government may be regarded as a favored party to whom debentures, without voting privileges but with a prior claim upon a portion of the selling value of the product, have been issued.

Detailed comparison of the statistical techniques and methodology used by Mr. Clark with those used by national income estimators in the United States is impossible. In both countries the basic data consist largely of statistics collected in connection with taxation, population and industry censuses and, in Great Britain, social insurance administration. Mr. Clark

has not made as much use of sample studies of family incomes and expenditures or industrial wage and income distributions as have American investigators. His calculations and his methods of interpolation of data available only in certain years are, on the whole, simpler and subjected to fewer refinements than those utilized by American investigators, and his estimates are for this reason probably less sensitive to year-to-year changes than estimates of national income in the United States. This may be due in part to the fact that Mr. Clark has been dependent upon his own resources and has therefore not been able to obtain as much assistance as American investigators for detailed analyses of specific problems.

On the other hand, Mr. Clark's study is far more comprehensive than any single American publication, and he shows a more thorough grasp than do American writers on national income and outlay of the economic significance and interrelations of the data with which he is dealing. In this respect his book is far superior to the publications of The Brookings Institution, *America's Capacity to Consume*, *The Formation of Capital*, and *Income and Economic Progress*, which are the American books most comparable in scope.

American readers of *National Income and Outlay* who are primarily interested in Mr. Clark's concepts and results are likely to be irritated by the insertion in the text of details regarding sources and mode of making calculations which in an American publication would be placed in an appendix, or at least gathered together in tabular form. This difficulty of style, however, is in part offset by an excellent 9–page summary, at the beginning of the book, giving the conclusions of each chapter. The student who is interested in tracing in detail specific sources and methods of calculation will also be irritated by the lack of page references to the sources used and by the absence of many of the necessary details of computation.

Mr. Clark's estimates indicate that the net national income of Great Britain (including northern Ireland) in 1934 was only 3 per cent less than in 1929. The figure in 1932 was about 12 per cent lower than in 1929. Comparison with the national income of the United States is difficult because of varying exchange rates and because of the difference in inclusiveness of the figures as compared with those published in the United States. If Mr. Clark's figures for 1929 and for 1934 are converted into dollars at the average rates of exchange during those years, respectively, the net national income in both years was equivalent to $21 billion. This may be compared with figures of approximately $92 billion and $60 billion in the United States for 1929 and 1934, respectively, if the Department of Commerce estimates are raised to include governmental income from indirect taxation and from services sold. Reduced to a per capita basis the figures amount, approximately, to $465 for Great Britain and $755 for the United States in 1929, and to $460 for Great Britain and $475 for the United States in 1934.

About three-fifths of the British national income is received in the form of wages or salaries, including pensions and social insurance benefits, and

about two-fifths as income from property, including profits, interest, rents, and all net income from overseas. Income from property is a somewhat larger percentage of the national income in Great Britain than in the United States. Despite this fact, however, in 1929 the national income in Great Britain was apparently distributed among individuals with slightly less inequality than in the United States. Comparison of the distribution curves of the two countries in 1934, when the average per capita income was nearly the same in the two countries, would be much more interesting and significant, but in neither country are distributions of personal incomes for that year available.

About half of the national income in Great Britain is derived from industry (manufacturing, mining, and construction), if indirect taxes are considered to be a part of the income drawn from industry, as compared with approximately one-third in the United States, computed on the same basis. The difference is due to the relatively greater importance of agriculture, financial institutions, and educational, recreational, and other services in the United States.

In 1932 approximately one-fourth of the national income of Great Britain was absorbed in the purchase of food, another fourth was used for dwelling-rents and various types of services, and a somewhat larger amount for retail purchases other than of food. Only about 3 per cent, including government expenditures for capital items, was devoted to capital expansion. Whether much difference exists between Great Britain and the United States in regard to the proportions of the national income spent for such major categories as food, home maintenance, clothing and personal care, other living, and capital expansion cannot be determined, since estimates are not available for both countries for the same year, and the differences between 1929 and 1932 appear to have been very great in both countries.

Perhaps the most interesting of Mr. Clark's conclusions relate to the accumulation of capital and the relation of such accumulation to economic progress. In 1929 and also in 1935 capital accumulation amounted to approximately 7 per cent of the national income, in comparison with about 10 per cent in the United States in 1929. The funds for capital expansion in Great Britain are obtained from undistributed profits of business concerns, savings for security by the working and middle classes, and local governments. Large private incomes are used wholly for consumption and have ceased to be a source of capital funds. Further, the rate of economic progress is not dependent upon the rate of capital accumulation. The replacement of obsolete capital by more efficient equipment, utilizing funds from depreciation allowances, appears to be the primary factor responsible for a rapid increase of productivity and a rapid rise in the standard of living of the population of Great Britain during recent years. The proportion of income saved and the amount of capital invested appear to be effects, rather than causes, of the changes associated with economic progress.

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Income Received in the Various States 1929–1935, by John A. Slaughter. New York: National Industrial Conference Board, Inc. N.I.C.B. Studies Number 234. May, 1937. xv, 167 pp. $3.50.

This work resembles somewhat the earlier efforts of Knauth and Leven in preparing state income estimates, but can more appropriately be described as a geographic apportionment of the national income estimates slightly revised from those recently published by the National Industrial Conference Board in Robert F. Martin's book, *National Income and Its Elements*. No new concepts are introduced or discussed, and the entire text, tables, and appendix relate to the methods of apportionment and to brief observations of the results. Thus, the concepts and scope of the estimates in this volume are subject to the same favorable or adverse criticisms as Martin's study.

If one were to group projects relating to quantitative measurements of economic phenomena into two major categories (page Louis Bean!), one including "scientific" statistics and the other including "operating" statistics, the contents of this study would be classified among the latter. It makes no original contribution to either the theory of income or to methods of measurement. On the other hand, the study provides workable and probably fairly accurate estimates of aggregate individuals' income for each state. It is probable that the margin of error in most of the state totals and in their relative positions would be found slight if compared with estimates prepared with greater care and precision. State estimates for some of the specific industrial groups, however, are probably of such questionable accuracy as to render their value doubtful. The author has properly grouped the estimates in broad industrial categories, particularly the weaker series.

The preparation of the estimates was made more difficult by the fact that results of the 1935 Census of Business were, in most cases, not yet available when the study was being prepared. The sources and methods are described in the appendix of the book, but the degree of detail in many instances is not sufficient to permit one to understand the exact sources of data and the precise treatment of the basic material involved in preparing the final estimates. Particularly inadequate were the descriptions of the estimates in those fields where the basic data are least abundant and the methods of estimation are necessarily indirect and involved. This criticism applies especially to the estimates for the government, service, and miscellaneous groups. Generally, it is desirable to be more specific in describing the weaker estimate so as to invite constructive suggestions.

In an effort to show complete estimates of the industrial origin of total "realized production income" for each state, the author had to make the very arbitrary assumption that the breakdown of receipts of dividends, interest, and net rents and royalties by industrial source was the same in each state as for the country as a whole. According to this procedure, if 40 per cent of all dividend payments to individuals in the country originate in the manufacturing industry, then it is assumed that 40 per cent of dividend receipts in each state originate in the manufacturing industry. This industrial

breakdown of property incomes in each state added little to the value of the study and in fact unnecessarily weakened the estimates. Certainly, laymen will not comprehend this assumption and its implications, and it would have been much better to limit the industrial breakdown to salaries and wages and to show only state aggregates for the property income items.

In conclusion, the author may be said to have presented in concise and usable form, an up-to-date series of estimates of income receipts in the various states which will no doubt prove useful and helpful to those in need of such data. For marketing and related purposes, the degree of accuracy is probably sufficient to serve the purpose at hand. To one interested in the most scientific and comprehensive estimates of state income possible, the volume leaves much to be desired.

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Long-Term Debts in the United States, by Donald C. Horton. Washington, D. C.: United States Government Printing Office. Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce. Domestic Commerce Series, No. 96. 1937. vi, 211 pp. 20 cents.

Private Long-Term Debt and Interest in the United States, by Leonard Kuvin. New York: National Industrial Conference Board, Inc. N.I.C.B. Studies No. 230. September 1936. xiv, 138 pp. $2.50.

The widespread interest since 1929 in problems of debt naturally has encouraged the growth of literature in the field, and the writings of Snyder, Clark and associates, Edie, Doane, Warren and Pearson, Fisher, and others have received much attention. The statistics of debt have been considerably improved, both through refinements by some of those just named and through closing of gaps in the figures by governmental and other surveys. But the investigator is still faced with important deficiencies in primary debt data—e.g., as to some classes of urban mortgages and as to the ownership of evidences of debt, particularly the holdings of individuals and trustees. A new debt study not concerned wholly with debt theory may devote itself in part, of course, to efforts to supply some of the missing statistics. Or it may also strive, obviously, for better marshalling and collating of available figures, clarification of the boundaries between classes of debt, an all-around betterment in definitions and estimates, or related refinements of concepts or data. It is chiefly, though by no means wholly, in the latter respects that the two studies by the present authors and their respective associates are significant.

Necessarily, the ground covered by the two investigations is alike, in substantial degree, but they do not resemble each other as closely as one might infer from the similarity of titles. Each is concerned primarily with private long-term debt, and each presents detailed estimates of the volume of such debt, by classes, and of the interest charges thereon—for 1912, 1922, 1930,

1934, and scattered figures for other years in Dr. Horton's report for the Department of Commerce, and for 1900 through 1935, yearly, in Mr. Kuvin's study for the National Industrial Conference Board. But, in addition, the former report contains numerous valuable tables on the age-distribution of the various debt classes, estimates on the extent of debt defaults, a detailed appendix of state mortgage-moratoria and related debtor-relief legislation, as well as (primarily for comparison with private debt data, it is stated) substantial chapters presenting the major outlines of public debt data—all topics not emphasized in the present report of the N.I.C.B. The latter study, on the other hand, treats in prominent fashion (approximately one-half of contents) of the economic aspects of debt, particularly of its relationships to income and to the various other economic values supporting the debt and interest structures—problems not within the scope of the Department of Commerce bulletin.

The two analyses yield estimates for the total volume of long-term private debt that are not as unlike as one might have anticipated from the differences in definitions as to what constitutes long-term debts—i.e., those maturing one year or more (with some exceptions) from original date of issue, in Department of Commerce treatment (p. 4), and those maturing five years or more from time of contraction, as viewed by the N.I.C.B. study (p. 2). The first-named study places total private long-term debt at $84.5 billion in 1930 and $73.4 billion in 1935, compared with estimates by the N.I.C.B. for similar dates of $85.8 billion and $76.9 billion, respectively. Estimated extent of decline in totals between the two dates is thus slightly greater for the former than for the latter debt estimates—i.e., 13 per cent versus 10 per cent. Although generalization is difficult, it appears that each study estimates the volume of private long-term debt in the early depression years to have been some 5 per cent to 10 per cent below the estimates of most prior investigators.

Although the two studies agree roughly as to private debt totals, the correlation appears to be partly accidental—differences in one direction for one type of debt happening to be partially or wholly offset by differences in the opposite direction for other items in the composites. These differences are not great except as to urban mortgage debt, which the Department of Commerce bulletin places at $37.2 billion in 1930 and $30.4 billion in 1934, compared with estimates of $43.0 billion and $36.6 billion, respectively, computed for the same years in the N.I.C.B. study. To some degree, these differences in urban debt estimates are explainable by differences in definition—the first-named study regarding as "Industrial" or other debt some data apparently classified by the N.I.C.B. as urban mortgage debt. Seemingly, however, these differences in definition do not account entirely for the discrepancies in the two estimates for urban mortgage debt.

The authors of the N.I.C.B. investigation report that, viewing the period since 1900 as a whole, they find little or no evidence to support the assertion that the increase in the total volume of long-term private debt has been at

a rate out of step with the growth of the nation's capacity to support it, as measured by a variable such as national income (p. 4). Questions of this type receive only incidental attention in the other study.

Gratifying features of each volume include extensive notes regarding methods of computation and source materials employed, as well as references to shortcomings in the latter, where known. Also commendable is the practice of presenting explanations for differences in the estimates of various previous investigators, as done for railroad debt in the N.I.C.B. report (p. 28). The authors of the Department of Commerce study have provided estimates of the range of error in their major data—warning signals to the reader unacquainted with the pitfalls in debt statistics. A similar worthy end is served by the practice of the N.I.C.B. report in classifying its major data into "accountable" and "unaccountable" groups, depending on the estimated degree of accuracy. The cautious reader will do well to examine with considerable care the methods employed to arrive at estimates for earlier years, where admittedly the difficulties of providing satisfactory data are considerable. Worthy perhaps of further investigation are the rather peculiar opposite trends during the first dozen years of the present century, shown by the rates of interest on certain classes of debt in the N.I.C.B. calculations (pp. 50, 51).

That all the facts with respect to the trend of interest burdens are not known is a point stressed by the authors of both works. In fact, the authors of the N.I.C.B. study regarded the available data on the trend of urban mortgage interest rates as so uncertain that they merely assumed a flat annual charge of 6¼ per cent throughout the period 1900–1935—a method not without its weaknesses, obviously. For multipliers in arriving at the burden of interest charges on urban mortgage debt, the compilers of the Department of Commerce report provided tentative estimates of the rates of interest on such debt for four base years (p. 210). These were assumed to be 6.5 per cent on all urban mortgage debt in 1922, 6.4 per cent for home mortgage debt and 6.2 per cent for other urban mortgages in 1934, with other estimates for 1912 and 1930. These are, of course, not estimated interest rates on new mortgage contracts made but assumed average rates on outstanding indebtedness.

Some question may be raised whether the difference between the rates assumed for 1922 and 1934 may not understate the extent of decline in urban mortgage interest rates between those dates. A study by the present reviewer of the published data for all savings banks in a leading state, and of figures reported publicly by life insurance companies that lend importantly on urban mortgages, revealed rates of interest charged that are well below those cited above—as, of course, is to be anticipated when one considers that the portfolios of these institutions are of first-mortgage character. But more significant in the present connection is the substantially greater extent of decline between 1922 and later dates shown by the average interest rates on outstanding urban mortgage portfolios of these savings banks and in-

surance companies than by the rates assumed in the Department of Commerce survey for urban mortgage debt generally. It may well be, of course, that trends in these urban first-mortgage interest rates are not truly typical of trends in the rates on the urban mortgage debt structure as a whole; present facts do not provide a final answer to that question.

Minor faults include the omission from a table in the Department of Commerce survey of an explanatory note to the effect that the data in the table are in millions of dollars (p. 2), and an apparent misapprehension in the N.I.C.B. study as to the number of legal-reserve life insurance companies in the United States—the term "legal reserve" being properly applicable to the 318 companies whose data are studied as well as to the smaller sample group of 51 companies (p. 115).

Both volumes obviously represent the results of painstaking and extensive investigation and rank well up among the more important contributions in the field of debt statistics.

CORLISS L. PARRY

New Canaan, Connecticut

Studies in the Theory of International Trade, by Jacob Viner. New York and London: Harper and Brothers. 1937. xv, 650 pp. $4.50.

This book, which consists of a series of studies rather than a treatise on international trade, will prove invaluable reading for the seasoned economist no less than for the novice in this specialized but all-important field. Furthermore, the studies are not confined to international trade alone but branch out into the field of British monetary controversy in the first half of the last century. Indeed, almost a third of the book is devoted to the bullionist and currency controversies as such, while, inevitably, a substantial portion of the remainder of the book is concerned with money and currency as well as international trade. But, as international trade and its operation cannot be discussed intelligently without reference to monetary and currency processes, Professor Viner had perforce to bring in these seemingly extraneous matters—extraneous, that is, to what a narrow interpretation of the title would lead one to expect.

In the first of the studies, attention is devoted to "English theories of foreign trade before Adam Smith." Then follows a discussion of British currency controversies—the bullionist controversy, and the currency school-banking school controversy. The remainder of the book takes up again the thread of international trade analysis. There is given a description of the "theory of the mechanism of adjustment of international balances" (1) "under an international simple specie currency, i.e., with the circulating medium consisting solely of standard metallic money," and (2) "in relation to the modern banking processes." The last chapters of the text, and the most absorbing, discuss the various theories of gains from foreign trade. The first of these two chapters comprises a defense of the comparative-costs

doctrine; the second analyzes the concept of the "maximization of real income." The bibliography (30 pages) seemingly leaves little to be desired, and the two indexes—one of names, the other of subjects—are also very well organized and quite comprehensive. While the preface states that the author's excellent article in the *Weltwirtschaftliches Archiv* (1932) was "substantially revised, recast, and extended, in the process of incorporation in this book" (p. xiv), this reviewer would alter the statement to say "was extended, in the process . . . "

The author finds full justification for a separate theory of *international* trade in the international immobilities of labor and natural resources, even in the face of perfect international mobility of capital and imperfect internal occupation mobility of all the factors (p. 598).

The attainment of the author's objective "to resurrect forgotten and overlooked material" (p. xiii) is well illustrated by the following, among many examples. He traces the "concept" of a national balance of trade back to 1381 (p. 6) and "the exact term itself" to 1615 (p. 8). "The term 'favorable balance of trade' . . . so commonly attributed to the mercantilists, seems first to have been used in 1767 by Sir James Steuart, although the phrase 'balance in our favor' had been used by Cary in 1695 . . . " (p. 10). "Invisible items" are not a recent discovery, but reference to them is found as early as 1381 (p. 13). The "infant-industry" argument should not be credited to Alexander Hamilton, but was of earlier origin, appearing in 1645 (p. 71). Even the "economic man" was not a creation of the classical school but a creature of the mercantilists (p. 93). Also, the tabular standard as a basis for contracts, the varying of the weight of coins, and currency convertibility on a fluctuating basis, were some of the currency reform proposals advocated early in the last century. Open-market operations too are not of recent origin (p. 257). Nor was the "non-automatic character of the modern gold standard . . . a discovery of the postwar period" (p. 388). The author also points out that "all the important elements in Adam Smith's free-trade doctrine had been presented prior to the *Wealth of Nations*" (p. 108). But, he claims, they developed from "philosophers, rather than . . . the earlier English economic literature" (p. 109).

The book suffers somewhat from its attempt to be encyclopaedic, to uphold or oppose every word written or even uttered by every recognized economist upon the subject of international trade. Furthermore, dogmatic dicta and caustic comments have no place in what is otherwise so scholarly a work and are diverting, to put it mildly, to the objective, scientific reader. Not every economist can or should subscribe to Professor Viner's theories, nor are all who disagree to be considered of smaller intellectual stature. The reviewer would have been better pleased, too, had the author scattered his hypercritical barbs more widely, giving them a greater dispersion, as it were.

In the opening chapters of the book, treating of mercantilism, it is shown that the mercantilist desire for favorable trade balances rested not only upon

increasing the store of precious metals, whatever the purpose—to increase state treasure, to raise prices, to increase trade, to obtain a store of wealth, etc. (Chapt. I, *passim*)—but also upon the hope of increasing employment. Larger exports and smaller imports, especially if the former were largely finished goods, meant greater employment in England (p. 51). The author's analysis of the mercantilists' plaint of "scarcity of money" indicates that it apparently meant all things to all men (p. 88). "The disparagement of consumption and the exaltation of frugality and thrift," in the pre-Adam Smith period, resulted not only from economic reasoning but also from moral, religious, and class precepts (p. 26).

But was it only mercantilist literature which identified the interest of its backers with the national welfare? Was it only mercantilist literature which "consisted of tracts which were partly or wholly, frankly or disguisedly, special pleas for special economic interests" (p. 59)? Rather, has not "disinterested exposition of trade doctrine," as of most economic and other social science doctrine, been conspicuous more often by its absence than by its presence? Further, was it only before Adam Smith that "appeal to political and religious considerations seems often to have been intended to win the support of [certain groups], and seems only rarely to have expressed what was really the primary concern of their authors" (p. 112)? Can we confine to that period the facts that "pleas for special interests, whether open or disguised, constituted the bulk of the mercantilist literature, [and that] the disinterested patriot or philosopher played a minor part in the development of mercantilist doctrine" (p. 115)?

Mercantilist doctrine receded for a time, with the advent of interpretation in terms of a price-specie-flow automatic mechanism. The steps necessary to set up that interpretation in successful "repudiation of certain of the monetary phases of mercantilist doctrine," included acceptance of the quantity theory of money, of sectional prices and their implications, and of the automatic self-adjustment of the international balances (p. 75).

The second portion of the book traces the course of the bullionist controversy in the first quarter or so of the nineteenth century. Professor Viner points out that in the course of that controversy "the germs at least of most of the current monetary theories are to be found" (p. 120).

In various sections of the book it is shown that the growth of central-bank consciousness by the Bank of England was slow and wavering. Central-bank objectives, in general, and the operations necessary to achieve them, under different situations, are presented in a convenient tabulation on page 395.

The statement "that the quantity of bank loans demanded is dependent on the rate of discount is now universally accepted by economists and need not be further argued" (p. 151) is, I think, but partly true, as can be witnessed by events of the recent half-dozen years or so, and it is even modified by the author's listing (p. 238) of other factors influencing the willingness of business men to borrow.

Professor Viner states that the chief contribution of the comparative-costs doctrine was "to correct the previously prevalent error that under free trade all commodities would necessarily tend to be produced in the locations where their real costs of production were lowest" (p. 441). This doctrine, stated as it was in terms of real costs, was not a denial of price influence, but "the real-cost analysis was intended to give significance to the analysis in pecuniary terms, and not to replace it" (p. 483). There was assumed at least a rough proportionality between market prices and real costs (p. 491). Professor Viner's admission, however, that "the course of international trade is governed immediately by prices" (p. 493), comes at a time when other factors than prices are beginning to assume a larger rôle.[1] But the author concludes that, even with the existence of more than one factor of production, the use of factors in varying proportions, and the inability to measure real costs (p. 508), the "doctrine of comparative costs emerges . . . very nearly intact" (p. 500). He seems to dismiss summarily those "economists who *believe* that they have at their command a superior technique than [the comparative-costs doctrine] affords for the appraisal of commercial policy" (p. 438). [Italics mine.]

The contrast between general-value theory and international value theory is noted (p. 583). While the former dealt with money prices and was a partial-equilibrium approach, the latter dealt with exchange ratios between commodities and was a general-equilibrium approach.

Professor Viner's apparent belief in never-changing, underlying fundamentals, coupled with his apparent denial that "what was sound reasoning" at some former time can be "unsound for the present-day world" (p. 111), fails to recognize that different circumstances and different periods of time call for different policies. He himself states, in defending Ricardo's change of heart, that "what would be glaring injustice in the one situation might well be defended as the closest approach to justice available in the other situation" (p. 205). He says also that short-term capital movements may be equilibrating (p. 365), or may operate perversely (p. 407), indicating that their very mobility may at one time be considered an asset and at another a liability.

I wonder whether criticism that a "defense of the theory is essentially empirical rather than analytical" (p. 384) is valid. Should appeal to facts be ignored in economic theorizing?

The *obiter dictum* that "economic analysis can . . . yield only strong presumptions, but this limit in the power of economic analysis extends to the entire field of welfare analysis" (p. 532) is well-taken and very neatly leads to the conclusion that "the theory of international trade, at its best, can provide only presumptions, not demonstrations . . . " (p. 593).

JAMES D. PARIS

Pelham, New York

[1] Cf. C. R. Whittlesey, *International Monetary Issues*, p. 130.

Die Britische Handelspolitik seit Ottawa und ihre weltwirtschaftlichen Auswirkungen, von Dr. Hans Schlie. Jena, Germany: Verlag von Gustav Fischer. Probleme der Weltwirtschaft. Schriften des Instituts für Weltwirtschaft an der Universität Kiel. Herausgegeben von Professor Andreas Predöhl. 1937. xvi, 241 pp. RM 12.–

This treatise on British commercial policy since 1932 is made particularly timely by the recent occurrence of another Imperial Conference on trade policy, as well as by the completion of a number of bilateral trade agreements by the United States. The book furnishes a description and analysis, chiefly statistical, of the development of British policy, the conflict in recent years between British, imperial, and international aims, the policy embarked upon at the Ottawa Conference, and its success up to the present. A rather exhaustive bibliography is included.

Dr. Schlie's theme is that English commercial policy is not to be explained in terms of English conditions alone. Following the confused economic policies characteristic of the postwar period, it became essential in many countries to reconsider both domestic and foreign commercial policies in the light of world conditions. The Ottawa treaty represented for Britain the initiation of a new policy—departure from traditional free trade for a policy of imperial preference designed to enhance imperial unity and prevent the development of an independent economic policy on the part of the Dominions.

The author's conclusion, based of course on only a brief period of operation of the new policy, is that the Ottawa Conference, implemented by the tariff measures which followed, seems to be achieving its purpose of binding the members of the Empire into a closer economic unity, partially, of course, at the expense of some of the countries whose trade with the British Empire formerly assumed large proportions.

MILDRED HARTSOUGH

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World Finances 1935–1937, by Paul Einzig. New York: The Macmillan Company. 1937. xvi, 342 pp. $3.00.

The author of this work is a brilliant and prolific writer on international finance. He has brought to the task of compiling the financial history of our times a keen awareness of the personalities, the politics, and the background of the social and economic developments responsible in large measure for the direction which financial events have taken. He is not, however—and he has made no attempt to conceal the fact—a disinterested and unbiased observer. In this work, just as in his *World Finance 1914–1935*, he has attempted to turn the history of the period into a demonstration of the validity of his own monetary views and of the futility of orthodoxy.

Nevertheless, the work is likely to be useful to the student of recent

monetary history, for, while the picture he has painted is colored by his convictions, significant trends and events are carefully and lucidly described. After a brief survey of the financial history of the period 1914–1935, Mr. Einzig has dealt with the events of the period 1935–1937 which offer a sorry picture of currency disintegration, of political and economic contradictions, and of fiscal blunders. The successive crises faced by the members of the gold bloc, the course of reflation, the development of new methods of monetary management, and the probable effects of rearmament on the financial outlook are all dealt with in considerable detail.

Mr. Einzig's interpretation of the facts is likely, however, to be irritating to most readers. He has been bitter and unsparing in his criticism of all that he considers orthodox. He has blamed some of the money managers for mistakes in policy and others for blunders in the method of applying policies which he has, in this as well as in other publications, approved. Furthermore, the method of treatment he has followed is far removed from that calm appraisal of events which is essential if the history of the period is to yield something of real value for the future. Fundamental to Mr. Einzig's point of view is the conviction that in most countries debts are so high that there is no alternative but to devalue currencies to a point where the advance in prices will reduce the burden of servicing them. He appears to see much more clearly than do most observers that fiscal heterodoxy is, over a long period of time, mutually inconsistent with monetary orthodoxy. He fails to give adequate weight, however, to the fact that monetary devaluation is a palliative and not a cure and that repeated doses of the inflation medicine cannot be taken without causing difficulties even more serious than those which would be alleviated.

He seems, moreover, to miss the most important point of all, namely, that many of the recent mistakes made by the monetary authorities have been the outgrowth of their frantic efforts to repair the damage caused by previous errors of policy and judgment. The moral should not have been that nations must devalue and inflate whenever political expediency has encouraged them to build up an unwieldy debt burden but rather that debts must not be expanded to a point where governments will be forced to repudiate them through inflation.

MURRAY SHIELDS

Irving Trust Company

A Program of Financial Research, National Bureau of Economic Research, in co-operation with Association of Reserve City Bankers.

Volume One: *Report of the Exploratory Committee on Financial Research of the National Bureau of Economic Research*. New York. 1937. Studies in Finance, Number One. x, 81 pp. $1.00.

Volume Two: *Inventory of Current Research on Financial Problems*. New York. 1937. Studies in Finance, Number One. viii, 253 pp. $1.50.

These two small volumes outline perhaps the most ambitious project for co-ordinating government, foundation, and private research in the field of financial economics that has yet been proposed.

Under this plan, the National Bureau of Economic Research is to seek the co-operation of Government, business, educational, and other interested agencies in sponsoring a permanent central staff. This staff is to inaugurate a comprehensive survey of the nation's financial structure, formulate specific research projects to study problems neglected by present investigators, launch commissions of inquiry on major questions of policy, and assure the publication of the results of this program so that they will be generally available.

Funds are to be raised from non-governmental sources to finance the central agency and the specific research projects inaugurated by it. The National Bureau of Economic Research has enjoyed the co-operation of the Association of Reserve City Bankers in working out this program.

The first of these two volumes contains recommendations for research co-ordination from the Exploratory Committee, consisting of Winfield W. Riefler, Walter Lichtenstein, David Friday, and J. H. Riddle. It contains also brief summaries of a number of suggested research projects, such as "Changes in the Capital Requirements of Business Enterprises," "Major Factors in the Fluctuations of Bank Deposits during the Past Decade," etc.

The second volume presents a summary of the work that is now going on in Government agencies, in commercial organizations, in research bodies, and by individuals in the field of finance. It is a helpful and impressive, if incomplete, survey of current research.

There can be little question that financial research at the present time suffers from a notable absence of co-ordination. This brings not only a large amount of duplication of effort but also the neglect of a number of problems. Hence, the establishment of a single central agency to co-ordinate and foster such research would be a commendable experiment.

As has been demonstrated by other attempts to co-ordinate any large field of intellectual activity where principles and methods are far from standardized, however, the results will largely depend upon the quality of the leadership that is offered. In the field of financial research particularly, sterile compilations of statistical data that prove the merely obvious have been presented all too frequently as original studies of complex problems. Co-ordination of research must at times be concerned as much with the discouragement of such arid and useless projects as with stimulating constructive and significant contributions to our understanding of financial institutions and trends. Some of the sample projects outlined by the Committee in the first of these two volumes clearly involve the risk of evoking merely more pretentious statistical restatements of well-known developments and tendencies, without adding to our knowledge of their nature and significance.

JULES I. BOGEN

The Journal of Commerce, New York
and New York University

Wholesaling, Principles and Practice, by Theodore N. Beckman and Nathanael H. Engle. New York: The Ronald Press Company. xvii, 628 pp. 1937. $4.00.

Although not a new edition or revision of *Wholesaling*, written by Professor Beckman and published in 1926, the present volume is so clearly a lineal descendant of the earlier book that comparison is inevitably invited. This procedure is particularly appropriate since the contrast between the two volumes reflects faithfully the increase in the general fund of knowledge about wholesaling and marketing during the decade between the two publication dates.

It is perhaps needless to state that, useful as the earlier volume is, the second represents a substantial advance: the continued researches of Professor Beckman, the addition of Mr. Engle, with his extensive background in the field, as coauthor, and the new data made available by the Census of Business are sufficient guarantees of that.

Whereas Professor Beckman's earlier book devoted 524 pages of a total of 596 to the internal problems of operation of wholesale enterprises, such as organization, brand policies, purchasing procedures, and warehouse operation, these topics have been compressed to 123 pages of a total of 600 in the new book. Since much of the material in the first volume is still pertinent, the two books may profitably be considered as complementary. The space released by this compression in Beckman and Engle has been utilized for a careful definition of wholesaling; a brief history of the development of wholesaling; a detailed survey of the present wholesaling structure in the United States, based largely on census data; an appraisal of the overall efficiency of wholesaling institutions; a summary statement of basic problems in the field; and an examination of the relations between government and wholesaling.

Rejecting all suggestions for more elaborate classification, the authors divide marketing into two categories, wholesaling and retailing, with the following definition of the former: "Wholesaling includes all marketing transactions in which the purchaser is actuated solely by a profit or business motive in making the purchase." Having taken their stand in favor of this delimitation of the boundaries of wholesaling, the authors point out the narrow view which associates wholesaling solely with the activities of wholesalers selling to retailers and the compromise made by the Census Bureau in including the marketing activities of manufacturers' sales branches but not of central offices.

The definition and classification adopted has much to recommend it. It is simple, and the criterion of the purchasers' objective is clear-cut for the most part, although there are some twilight zones. But there are disadvantages in bringing within the boundaries the marketing activities of farmers, prime producers, manufacturers, assemblers of waste products, mill supply houses, without subsequent subclassification which emphasizes the essential

difference in function and method of operation between the *assembler* of raw materials at one end of the marketing chain and the *distributor* of finished products at the other. Again, although it is true that the manufacturer who distributes his products direct to retailers performs wholesale functions, it would seem that his objectives and methods differed sufficiently from those of wholesalers assembling products from many sources for distribution to retailers to cast some doubt on the desirability of including both in the same category. A curious confirmation of the validity of the question lies in the fact that, in spite of the title of the volume and the definition adopted, the authors devote very little attention to the marketing activities of manufacturers, and that little appears in a chapter entitled "Circumventing the Wholesaler."

The analysis of the data made available by the Census Bureau, with which work both authors were associated, is a particularly useful section. The chapter on the efficiency of wholesale institutions raises some questions which need not be detailed here but represents a suggestive approach.

In summary, the volume is one with which everyone interested in marketing should be familiar.

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Big Business: Its Growth and Its Place. New York: Prepared under the Auspices of the Corporation Survey Committee of the Twentieth Century Fund, Inc. 1937. xv, 102 pp. $1.35.

Because of the great importance of the large corporation in our modern economy, each new effort to measure the growth and extent of corporate concentration must be welcomed and carefully appraised. The first result of the recent survey of "Big Business" conducted by Dr. Rufus Tucker for the Twentieth Century Fund has appeared under the title *Big Business: Its Growth and Its Place.* This small volume purports to cover the growth and extent of incorporation, the rise of large corporations, and the degree of corporate concentration according to various measures. But since the discussion of the rise of large corporations is devoted almost solely to summarizing the results of two well-known studies of industrial mergers, the volume must be judged by the evidence presented as to the present position of large corporations.

As a first step in arriving at the role of large corporations, the report presents figures which purport to represent the percentage of the 1929 national income produced by corporations in each major branch of the economy and for the economy as a whole. According to these figures, 57 per cent of the national income of that year was produced by corporations (page 17). No indication is given as to how these figures were arrived at. A footnote

explains that "sufficient space is not available to explain the methods used to arrive at the estimates of the percentage of income produced by corporations." For three branches of activity the estimates appear to be rounded thirds. As these estimates are used as a base in establishing the role of large corporations, the lack of supporting evidence is unfortunate.

In the second step depicting the role of large corporations, the relative position of the large corporations with respect to all corporations is measured by assets and by income. In the measuring by assets, any corporation with assets over 50 million dollars is classed as large, and, using the raw "Statistics of Income" figures, the conclusion is reached that, in 1933, 594 large corporations owned 53.2 per cent of all corporate assets and that, if only nonfinancial corporations are considered, 375 corporations owned 56.2 per cent of total corporate assets (page 54). Similar crude figures show that, excluding investments in other corporations, 49.9 per cent of corporate assets are owned by large corporations and 55.0 per cent of capital assets (land, buildings, and equipment) belong to the big companies (page 65).

In spite of the large degree of concentration of corporate wealth shown in this picture, it appears to minimize the true degree of concentration. The crude figures supplied by the Bureau of Internal Revenue in its "Statistics of Income" do not consolidate subsidiary companies except when the parent company owns at least 95 per cent of the voting stock and not always then.

An unpublished sampling study made by the present writer indicates that for nonfinancial corporations the assets shown in fully consolidated statements are appreciably greater than the assets shown in the partially consolidated statements filed by the same big companies in their income tax returns. The "investments" of the big companies represented in part voting control over other companies. For every dollar of "investments other than tax exempts" the sample group of companies controlled appreciably more than a dollar of assets other than investments. A rough indication of the magnitude of the underestimates resulting from the use of partially consolidated returns can be obtained by making the very conservative assumption that every dollar of investment other than tax exempts represents only 50 cents worth of assets other than investments and that securities held by financial companies are pure investments. In the table below a comparison is made between the results obtained by the Twentieth Century Fund using partially consolidated returns and the results obtained by completing the consolidation on the basis of the conservative assumptions given above. Since the basis used here for completing the consolidation is crude, the results cannot be regarded as at all accurate. They probably tend, however, to minimize the degree of concentration as the basic assets represented by a dollar of investments are more likely to be in the vicinity of a dollar rather than 50 cents. Certainly these figures suggest the extent to which the Twentieth Century Fund report minimizes the degree of corporate concentration.

In the text of the Fund report, this understatement due to the use of partially consolidated statements is mentioned in passing (page 56), but no

effort is made to adjust for this inadequacy, and the figures obtained are interpreted as if there were no significant underestimate. This was done in spite of the clear warnings in earlier writings on the subject which were available to the Fund.

	Proportion of Assets Held by Corporations with 50 Million Assets or More	
	Calculated by 20th Century Fund on basis of partially consolidated statements	Estimated conservatively on basis of crude adjustment to approximate complete consolidation[1]
For all corporations		
Total assets	53.2	56.8
Total assets less investments other than tax-exempt	49.9	54.3
Capital assets (land, buildings, and equipment, less depreciation)	55.1	61.6
For nonfinancial corporations		
Total assets	56.2	60.6

[1] According to information obtained from the Bureau of Internal Revenue, the investments other than tax exempts reported in 1933 by nonfinancial corporations with assets over 50 million dollars amounted to 17,747 million dollars. The adjustment for partial consolidation was made by assuming that through the ownership of these securities the large corporations controlled 8,874 million dollars worth of assets other than securities. It was also assumed that this 8,874 million dollars of assets was controlled by the ownership of 4,437 million dollars worth of securities.

In estimating the degree of corporate concentration on the basis of income, the same failure to make any adjustment for partial consolidation exists. In this case no mention at all is made of the underestimate resulting, and the estimates arrived at are treated as if no underestimate existed. Thus the estimates of the role of the large corporations, in relation to all corporations based on assets and income greatly underestimate their true significance.

The third step in picturing the role of the large corporations is taken by estimating the proportion of the total national income produced by the large corporations in the major branches of industry and for the national economy as a whole. This is done by apportioning the figures of national income produced by corporations between large and smaller corporations. The basis used for making this apportionment is neither assets nor income but the "compiled receipts" reported to the Treasury in income tax returns and roughly representing the volume of sales for each enterprise reporting. This procedure compounds the underestimate due to the use of partially consolidated statements with a second underestimate of perhaps even greater importance. "Compiled receipts" represent the total receipts of an enterprise, not its contribution to national income. It can only be a good basis for apportioning national income produced between large and small enterprises if the small companies on the average contribute about the same amount to national income per dollar of sales as is contributed by the large companies. Since the large companies tend to be more integrated than the small, a given dollar of sales is likely to cover more stages in the industrial process than in the case of a small company. Thus when a Ford produces

coal, uses it to make coke, then steel, then automobiles, the "compiled receipts" of the company include only the money received from the sale of the car. If each activity were carried on by a separate enterprise there would be a recording of "compiled receipts" between each enterprise, one for coal, another for coke, another for steel, and finally the same figure of receipt for the completed car as in the case of the integrated company. Thus for contributing equally to the national income, the integrated company would report a much smaller figure of "compiled receipts" than the sum of the "compiled receipts" of the unintegrated companies doing the same job. The integrated company will contribute more to the national income per dollar of sales than each unintegrated company. Since the large corporations are integrated to a greater extent than smaller corporations, the use of "compiled receipts" as a basis for apportioning national income produced tends to minimize the national income produced by the large corporations.

Using "compiled receipts" as a basis of apportionment, the report presents figures indicating that only 32.3 per cent of the national income produced by corporations is produced by large corporations.[2] This is a surprisingly small proportion in the light of the Twentieth Century Fund's own figures which indicate that 53.2 per cent of the assets of all corporations are owned by the large companies. Although the proportion of all corporate assets which are owned by the large companies is undoubtedly greater than the proportion of the corporate contribution to national income, such a great difference as that between 53.2 per cent and 32.3 per cent seems unlikely. Much of the discrepancy is undoubtedly due to the faulty character of "compiled receipts" as an index of "national income produced." Both figures would, of course, be revised upward by complete consolidation of legally controlled subsidiaries.

Once this questionable figure of 32.3 per cent is arrived at, it is used to apportion the national income produced by corporations (the unsupported figure of 57 per cent) between the large and smaller corporations. The resulting figure of 18.4 per cent representing the proportion of the national income produced by large corporations is unquestionably an underestimate. If the apportionment between large and smaller corporations were made on the basis of consolidated assets, the resulting figure for the contribution of large corporations to the national income would be approximately 32 per cent. The true figure is likely to lie midway between these two extremes, say at least 25 per cent.[3] Crude though this figure is, it does indicate the magnitude of the underestimate involved.

The fact that all the errors pointed out above lead to underestimates of the role of "big business" should not be lost to sight. Throughout this Twentieth Century Fund report there appears to be a consistent tendency to minimize the importance of the large corporations and to maximize the importance of small enterprise. This finds expression in the concluding section

[2] The figure of 32.3 per cent is not presented in the report directly but only by implication.

[3] This figure would imply that 44 per cent of the national income produced by corporations was produced by the large companies if 57 per cent of all national income was produced by corporations.

which says, after stating that only 18.4 per cent of the national income was produced by large corporations, "from this point of view the large corporation sinks into relative insignificance" (page 99). This tendency is reflected in the frequent treatment of government activity as if it were carried on by small enterprises. Thus, one of the main conclusions of the book reads, " . . . taking the broadest view, it can be truthfully said that 81 per cent of all American economic activity is carried on by medium or small corporations, by firms which are not incorporated at all, or by individuals" (page 98). To get this statement from the figures of the report, government must be classed as a medium or small corporation, as an unincorporated firm or else as an individual. Again it is stated that "more than two-fifths of the entire business activity in the United States is not in corporate hands at all —much less in the grip of the giants" (page 98). Here government is classed as "business" (as is also the activity of domestic servants) and is included as part of the business activity not in the hands of giants—there are few corporations that employ more people than the city of New York and none that employ more than the Federal Government.

Throughout the book as a whole this verbal bias has been mostly removed. The statistical bias, however, remains. Only the more glaring cases have been pointed to in this review, these errors make both the total figures of concentration and the industry-by-industry figures unreliable. No mention has been made of numerous minor errors, yet without exception they all tend to minimize the degree of corporate concentration.

The only significant contribution which this book makes beyond its title is the publication of an excellent chart (page 42) prepared by the Bureau of the Census at the request of the Twentieth Century Fund. This chart shows the proportion of wage earners employed by the largest companies in each of 84 industries and is in great contrast to the statistical weakness of the report.

GARDINER C. MEANS

Washington, D. C.

How Profitable is Big Business? New York: Twentieth Century Fund, Inc. Prepared under the direction of the Corporation Survey Committee of the Twentieth Century Fund, Inc. 1937. xviii, 201 pp. $2.00.

With the publication of *How Profitable is Big Business?* a worth-while addition is made to the now fairly sizable collection of monographs devoted to a study of corporate profits. In the foreword the reader is informed that the authors have attempted to answer certain questions about the relation between size and profits, size and income and outgo, size and turnover of capital, size and dividends. The statement is made also that only factual conclusions drawn from statistical material presented have been set forth. In short, the reader is warned not to look for economic judgments or suggestions for action.

In form and style the book is admirably done for the reader who turns to the book solely to glean the factual information promised. The sources

and limitations of the data presented, and the accounting concepts used, are adequately discussed. The actual study is divided into two sections (the book is presented in four parts) differentiated chiefly by the source of the data used.

In Part II profits of large versus small corporations are studied by utilizing *Statistics of Income*.[1] These data unfortunately cover only the three years 1931, 1932, 1933, but of course include records of hundreds of thousands of corporations and are broken down into size and industry classifications. Furthermore, the accounting concepts used, net income on net worth, total profits on total capitalization, etc., are applied separately to all corporations, to profitable and to nonprofitable corporations. Part II also includes a brief consideration of banking profits based upon data compiled by the Federal Reserve Committee on Branch, Group and Chain Banking.

In Part III data extending over the period 1900–1935 are presented for several groups of large corporations. Different groups of corporations were studied for selected intervals within this span of years; the data used were compiled from financial manuals. In this section emphasis is given to the fate of mythical investors in various assortments of shares of the corporations studied. In view of the difficulties and limitations involved in such procedure, undoubtedly recognized by the authors, the reviewer believes that Part III might have been omitted without impairing the value of the monograph.

Of interest to the student of corporate profits is that portion of the appendix material which adjusts the ratios net income to net worth and total profit to total capitalization by smoothing out differences in the percentage of gross income allotted to officers' compensation and to depreciation and depletion accounts. In general, for profitable corporations the adjusted ratios exhibit the same trends and differences by size groups as the unadjusted ratios presented in the text. For unprofitable and for all corporations interesting deviations arise. These, for the most part, are not explained by the authors. Despite the foreword warning that the study would be purely factual, the reviewer must confess to disappointment not only in the brevity of the chapter titled "Conclusions," but in the paucity of analytical treatment throughout the book. Among the conclusions reached are the following:

1. There are characteristic differences among classes of corporations of various size.
2. On the whole the largest corporations were the most profitable if profit on gross income is used as the criterion of profitable.
3. Among money-making corporations the smallest corporations were the most profitable if profitableness is measured by relating net income to net worth, or total profit to total capitalization.
4. There is an inverse relationship between size (of assets) and turnover (of assets).

[1] United States Treasury Department, Bureau of Internal Revenue.

5. The percentage of net income paid in dividends increases with increasing corporate size.

6. Larger corporations have "sounder financial set-ups" and are "safer."

The first four of the above conclusions were published in June, 1934, by W. L. Crum in his analysis of *Statistics of Income* for the year 1931.[2] The remaining conclusions cited above are perplexing. Over a period of years, of two corporations, the one which plows back the larger percentage of earnings, other things being equal, will show a relatively greater increase in the ratio of surplus to total capitalization. Hence if the dividend-net income ratios for large and small corporations were to continue the relationship shown for the years 1931, 1932, 1933 one would expect that the "financial setups" of the larger corporations would deteriorate relatively to the smaller corporations. (Granted that the percentage of surplus to total capitalization is a criterion of "soundness.") The authors justify their conclusion that large corporations are "safer" on two grounds:

(1) the larger corporations have "a smaller proportion of borrowed capital in their financial structure;"

(2) "compared with the smaller ones, a larger proportion of their borrowed capital has fixed maturity dates."

The data presented (Table 15, page 60) show that for corporations showing net income the smallest size class borrowed 29.9 per cent of total capitalization; the largest size class 29 per cent. The size class which showed the smallest proportion of debt, 20.2 per cent, was third from the largest of the nine classifications given. To the reviewer the slightness of the disparity between large and small corporations with respect to the proportion of borrowed capital is more striking than the statistical fact that "large corporations have a smaller proportion of borrowed capital."

The authors' statement to the effect that fixed debt is less onerous than floating debt is interesting but is, of course, offered without statistical verification and hence departs from the factual conclusions to which they were committed. In fact they present data (Table 15) showing that in each size group for profitable corporations the floating debt is a larger proportion of total debt than in the case of unprofitable corporations.

These comments on the authors' conclusions are not intended to belittle the value of their research. The book raises many questions not expressed by the authors and will tempt the reader to develop his own interpretations and analyses. It must be emphasized that the authors were not committed to analytical treatment. Furthermore, the book is a summary of certain chapters of a forthcoming study in which economic judgments and suggestions for action will be formulated. Perusal of *How Profitable is Big Business?* leaves one eager to examine the final results of this valuable research project.

SAMUEL S. STRATTON

Graduate School of Business Administration
Harvard University

[2] *The Effect of Size on Corporate Earnings and Condition*, William Leonard Crum, Business Research Studies, No. 8, Harvard University, Graduate School of Business Administration.

NRA Economic Planning, by Charles Fredrick Roos. Bloomington, Indiana: The Principia Press, Inc. Cowles Commission for Research in Economics, Monograph No. 2. xxii, 596 pp. $5.00.

Much of this book is based upon the author's experience as former Director of Research of the National Recovery Administration and consists of a rather personalized account of the formulation of the policies and the administration of the NRA. Few features of the measure are approved, and the program as a whole is described as "the monstrosity that during 1934 and 1935 had kept business in a churn, prevented reemployment, and consequently retarded American development."

In developing his thesis the author traces the growth of the idea of the NRA and discusses the difficulties encountered in recruiting a competent staff and in attempting to regulate hours of labor, wages, collective bargaining, and prices. Only a suggestion of the detailed treatment accorded these various topics can be presented here.

Decreasing hours of labor simultaneously in all industries probably slowed down improvement in the standard of living. Minimum wages resulted in an abnormally large number of workers receiving near the minimum, and multi-minima wage rates were responsible for some migration of industry and population to lower-wage regions. But since there were many increases in wage rates above the minimum, there was probably no reduction in the average wages for all industries.

The labor union movement was in the doldrums on the eve of the NRA because of labor's inability to establish a constructive program. Although Section 7 (a) did not supply a program it did provide an effective stimulus to the unionization movement and possibly led labor leaders to overreach themselves. They are criticized for not knowing when to stop in their demands and are admonished to study modern economic theory.

The problem of regulating prices under the NRA is approached through a consideration of cost. After a discussion of the difficulty of arriving at a workable concept of cost, the phenomenon is summarized as "an arbitrary or fictitious quantity which enables a business man to conduct his affairs with some degree of intelligence." That such an amorphous concept was an unsatisfactory basis for price regulation is amply attested.

The open price policy which was included in many of the codes is appraised as being the most important reform attempted under the NRA, although, as the author points out, the open price policy made for coercion and monopolistic control and was frequently ruinous to small business.

Economic planning under the NRA was "little more than the swapping of bargaining positions—monopolistic advantages for labor concessions—with the choicest gains going to the groups exhibiting the greatest political power . . . . And since such planning prevailed under the NRA, we must commend the Supreme Court for invalidating the Act. Recovery in substantial measure could not set in until this was done."

Assembling and analyzing statistical data is regarded by the author as constituting the most important problem of direct-control economic planning. He asserts that "as long as such large gaps in statistical information exist economic planning, even of a mild 'fixing' type must remain impracticable." In making this assertion he ignores the obvious fact that in our society statistics may be piled on statistics like Ossa on Pelion unto the seventh heaven without protecting the choicest gains from going to the groups exhibiting the greatest political power. Moreover, it might reasonably be argued that this fact does not constitute a forbidding barrier to fundamental social and economic reform.

In general the study is dominated by the traditions of classical economic theory, which lead the author to the conclusion that many of the NRA's troubles were traceable to "its failure to establish broad policies resting on long-established principles based upon common sense." Thus one gets the impression that the choice ultimately rests between a planned society and the *status quo ante*. Such an approach, which avoids the necessity of critically analyzing the forces that in the past have determined rights and privileges, places at a disadvantage any measures which threaten to modify social arrangements. Had the author given more attention to the critical social and economic conditions which existed during the months immediately preceding the inauguration of the NRA he might have had more difficulty in developing his *ex post facto* arguments to support the Supreme Court in its unanimous adverse decision.

COLLIS STOCKING

Washington, D. C.

Controlling Retailers, A Study of Co-operation and Control in the Retail Trade with Special Reference to the N.R.A., by Ruth Prince Mack. New York: Columbia University Press. London: P. S. King & Son, Ltd. 1936. Studies in History, Economics and Public Law, No. 423. Edited by the Faculty of Political Science of Columbia University. 551 pp. $4.50.

In the words of the late Allyn Young, if human behavior turns out to be something radically different from what is generally assumed in economic theory, the extent to which economics must still be rewritten is little understood. The thought that the basic assumptions as to human motives and reactions upon which the structure of economic theory has been erected may not have been wholly adequate for the relatively static conditions of the period in which they were formulated, and are certainly inadequate for a period the outstanding characteristic of which is rapid change, has been disturbing an increasing number of students in recent years. This disturbance has led to an intensified study of human behavior from many angles, accompanied by a general desire to adapt and use, so far as possible, laboratory techniques.

One such study is reported on in *Controlling Retailers*, by Mrs. Ruth

Prince Mack. Mrs. Mack's objective in studying the development, administration, and results of the N.R.A. General Retail Code was "to view the actual behavior of business men in order to learn what assumptions could properly be made concerning their economic nature and, conversely, to see the full implications of these assumptions when reflected in a pattern of action." As sources for her material, Mrs. Mack combined employment on the staff of the New York Retail Code Authority with what was obviously a tremendous amount of individual investigation. The result is a substantial volume, carefully documented and closely reasoned. The conclusion with respect to the specific N.R.A. experiment that "the operation of the Retail Code, in the setting in which it was placed, did not substantially further the public interest" is not startling and coincides with the judgment of many observers working perhaps with less detailed materials. The conclusion on the broader question embodied in Mrs. Mack's stated objective will not prove satisfying to seekers of the novel and revolutionary. She writes: "Behavior in relation to N.R.A. was typically predicated on self-interest; it was based on a judgment as to the direction of business advantage. Moreover the conception of self-interest was narrow; it was not extended in either the time or space dimension—business men were more concerned with advantage in two months than in two or ten years; there was little extension of the idea of 'self' to include other members of the trade and none to include all business men." This conclusion leads Mrs. Mack to a scrutiny of the types of pressures which may be brought to bear in lieu of voluntary cooperation, which scrutiny in turn ends with the final conclusion that "legislation of the N.R.A. variety deals largely with a category of economic phenomena which either cannot be controlled at all or controlled only at an excessive price."

Obviously many proponents of control will challenge Mrs. Mack's concept of what constitutes an excessive price. Moreover, the brief period during which the N.R.A. was in operation may be advanced in extenuation of its shortcomings. Nevertheless, Mrs. Mack has marshalled an imposing, and to this reviewer a convincing, array of evidence in support of her position.

Mrs. Mack makes her way to her conclusions through four sections devoted respectively to "Pre-Code Co-operation and Controls," "The Genesis of the Code," "Code Administration," and "The Retail Trade Under the N.R.A." The first adds little to the available material but undoubtedly is a necessary prelude to what follows. The sections on the "Genesis of the Code and Code Administration" reveal care and persistency in unraveling a tangle of motives and events and provide a convenient summary. To most readers the section on "Retail Trade Under the N.R.A." should prove of most interest. This survey of the effects of labor and "fair trade" clauses on all parties at interest, employes, stores, resources, and customers, is the direct basis for the conclusions already cited.

This book is definitely not one for the casual reader. Nor do all parts

equally repay close attention by the interested student. Nevertheless, Mrs. Mack has clearly made a definite contribution to the growing literature on social control of economic activity.

STANLEY F. TEELE

Harvard University

Sugar, A Case Study of Government Control, by John E. Dalton. New York: The Macmillan Company. 1937. x, 311 pp. $3.00.

The rapid expansion of Federal control of economic activities under the Roosevelt Administration has given rise to loose and acrimonious debate concerning the role of the State in economic life:

> The point of view held throughout this book is that discussion of the merits or demerits of the enlargement of Federal power in such general, vague, and elusive terms as "private initiative," "control of economic forces," "interference with property rights," or "planned or planless economy," is not conducive to a sane and effective analysis of a difficult problem . . . what is sorely needed is a specific inquiry into a long list of cases where government and business have come into contact. . . . The primary purpose of this study is to ascertain the past and present relationship of economics to politics in a major food industry, sugar, in order that these findings may be checked against the convictions commonly held by business men in the larger realm of business and government. . . . Emphasis is placed upon the existence of a national problem requiring a national political solution, rather than upon the wisdom of any particular solution. This is done with the conviction that the most effective method of studying the necessarily complicated problem of government and business is to examine, by the case method, the facts as they have been disclosed (pp. 6–9).

Following this statement of scope and method are seventeen brief chapters reviewing and analyzing the relations which have existed between the Federal Government and the sugar industry (this term includes the sugar industries of continental United States, the insular areas, and Cuba) from 1789 to 1936. After a general description of the sugar industry in recent years, Dr. Dalton traces the evolution of government policy toward sugar through the Great War; then turns to a consideration of the world depression in sugar which set in after 1925, its impact upon the areas supplying the United States, and the unsuccessful attempt to offset the decline in the price of sugar by raising duties in the Smoot-Hawley Tariff of 1930.

Not only did this action fail to lift the domestic price of sugar but operated to reduce imports into the United States from Cuba, thereby aggravating the economic distress which had already gripped the island. A new solution was sought in a quota system which allocated the annual consumption of sugar in the United States among the several producing areas and involved a large reduction in the duties on Cuban sugar. The quotas were established under the Jones-Costigan amendment (1934) to the Agricultural

Adjustment Act of 1933, and the Cuban duties were reduced, first under the flexible tariff provisions of the Tariff Act of 1930, and later under the Trade Agreements Act of 1934.

In dealing with the quota system, Dr. Dalton describes the abortive stabilization agreement which the sugar industry formulated under the marketing agreement sections of the Agricultural Adjustment Act, the government's plan as embodied in the Jones-Costigan Act, the establishment and administration of the marketing quotas, and the synchronization of production with marketing quotas by means of production adjustment contracts. After this general account, the individual producing areas are treated separately. Each of these analyses includes an historical sketch of the development of sugar production, an appraisal of the effects of tariff policy and the quota system, and an outline of future problems. Lastly come chapters devoted to the domestic refining industry, the consumer interest, and a reconsideration of the general problem of the relation of government to business.

As an historical account of the development of the sugar industry under tariff protection and as an analysis of the background and operation of the Jones-Costigan quota system, Dr. Dalton's volume is excellent. It is lucidly written: a noteworthy accomplishment in view of the complexity of the subject and the fact that a very considerable amount of statistical material is incorporated into the text. The author's close contact with the sugar problem as Chief of the Sugar Section in 1934 and 1935 imparts a flavor of realism frequently absent in economic writing.

In the final chapter, Dr. Dalton links the case of sugar to the wider problem of government and business which was touched upon in the opening chapter. Although admitting that sugar is a special case, he contends that it throws light upon the general problem. The conclusions are: that the roles of government and business cannot be rigidly separated; that government policies may be as important as the forces of free enterprise in the development of an industry; that Federal control once given is difficult to withdraw; that although some industries possess leadership sufficiently strong to carry out general programs, many require government supervision; "that the revolt against government regulation comes primarily when that regulation diminishes the prospects of profit, not when it improves them" (p. 306); that the extent to which government rationalization of industry is feasible varies from industry to industry; that business cannot call for more government assistance on the one hand and demand a reduction of the Federal bureaucracy on the other; that the complaint that business is being constantly upset by legislative surprises is largely unwarranted, since most legislation has its roots in the demands of business itself; and that, contrary to common statement, the government is quite capable of assembling a competent personnel to administer public policies. Dr. Dalton concludes that:

> What is imperative is not so much the creation of a trained administrative staff, but the setting up of appropriate government machinery in the Federal sphere to evaluate the claims for assistance that are constantly advanced by agricultural, business, and labor groups (p. 309).

It is with respect to these general aspects of the relation of government to business that certain questions arise in the mind of the reviewer. Although agreeing that "careless declamation" is of no help in solving the general problem of government and private enterprise, the reviewer believes that Dr. Dalton, in his preoccupation with the case approach, has underestimated the extent to which general economic reasoning is helpful in working toward a solution. The penetrating essays of Professor Pigou, issued under the title of "Economics in Practice" come to mind as an example of what may be accomplished along this line. Throughout his treatment, Dr. Dalton appears to consider the relations of the government to business in terms of conferring assistance on, or withholding it from, claimant groups. Although this is one phase of the matter, it hardly covers the entire field. Legislation aiming at the settlement of labor disputes, the enforcement of fair trade practices, the stimulation of reciprocal trade, and the conservation of natural resources are in rather a different category from measures designed to increase the profitability of individual industries. Thinking upon policies such as these must needs run in terms other than those of giving or withholding assistance.

Although Dr. Dalton's conclusions are interesting and valuable, it is disappointing not to find an analysis of the general problem of subsidies and the implications of quota control. The reviewer is aware that Dr. Dalton explicitly stated (p. 6) that he did not intend to evaluate the sugar program as such and is not complaining of the absence of a critical evaluation of the Jones-Costigan program or that Dr. Dalton did not present his own suggestions on a long-run program for sugar. The situation in sugar, however, clearly raises the whole problem of the desirability and standards of subsidizing domestic industries and also that of the conflict of interest between protected domestic producers and the producers of export commodities. Furthermore, the technique of quota control carries implications that are certainly germane to the problem of government and business. The traditional protective tariff, although distorting the economic structure, does not prevent the functioning of the international price mechanism. But quotas, as Professor Haberler has pointed out, are alien to the price system. They break down the interaction between domestic and international prices and prevent adjustments in production which would otherwise have taken place. It seems to the reviewer that some generalizations with respect to these problems might well have found a place in the final chapter.

J. P. CAVIN

Washington, D. C.

Marketing Research—Its Function, Scope, and Method, by D. M. Phelps. Michigan: Bureau of Business Research, University of Michigan. Michigan Business Studies, Volume VIII, Number 2. 1937. iv, 149 pp. $1.00.

In this monograph Professor Phelps has dealt with the philosophy rather than the technique of marketing research. From reading it the average teacher of marketing or director of marketing research will probably derive no new fact concerning this type of activity nor will he learn any new method used in carrying it on. When he lays the book down, however, he should feel, if he has read it carefully, that his ideas concerning the subject have undergone a process of orientation and that, as a result of its perusal, he is possessed of a much clearer concept of the relation of marketing research to the several phases of human thought and activity upon which it impinges.

The first of the three parts of the study deals with the place of marketing research in economic theory. The discussion of this phase of the subject centers around the use of this activity as a means by which the market may be intelligently anticipated in the course of the so-called "round-about" method of production. Through its use the enterpriser who must manufacture in anticipation of demand can suit both the characteristics of the article he produces and the amount of it he makes more precisely to the future requirements of the market than was possible under the old system of glorified guesswork. It thus makes it possible for such movements as the mechanization of industry, large-scale production, and division of labor to be carried to lengths to which they could otherwise not be developed without a dangerous enhancement of the risks of business enterprise.

The second section of the study relates marketing research to the work of the executive who is charged with managing the distribution activities of a business. This involves an analysis of the task of this official which is found to consist mainly of the manipulation of demand and the control of marketing efforts and expenditures. The section includes numerous examples of studies which have been useful in this managerial work.

In a third section the question of the extent to which marketing research is scientific in its attitude and technique is discussed. It is pointed out that those engaged in this work make rather more use of the inductive than they do of the deductive approach. In its use of the inductive method, also, marketing research relies much more on observation than upon experimentation in the collection of facts for analysis; for the material with which it deals is of such a character that usually none of the causal elements involved therein can be controlled. A number of examples of the successful use of the experimental method are described, however. Brief sections are devoted to the description of the historical and statistical types of the observational technique.

This is not a book which practical marketing research men will be tempted to keep on their desks as a technical guide to their daily activities, but both

they and those who teach the subject will do well to recall from time to time some of the ideas contained therein to the end that they may at all times be aware of the configuration and general location of the marketing research woods as well as of its individual trees with which they are by virtue of their daily work all too familiar.

R. S. ALEXANDER

Columbia University

Sources of Current Trade Statistics, by Jettie Turner. Washington, D. C.: Bureau of Foreign and Domestic Commerce, United States Department of Commerce. Market Research Series No. 13. June 1937. vii, 47 pp. 25 cents.

The streamlined model of *Sources of Current Trade Statistics* brought out in June 1937, by the Bureau of Foreign and Domestic Commerce is as much improved over the previous edition (1934) as that edition was over the "Model T" original, published in 1933.

Designed "to list current economic statistics, with the name and address of each compiling or collecting agency," this directory catalogues statistics on production, machine activity, new orders, unfilled orders, sales, shipments, receipts, consumption, stocks, wholesale prices, retail prices, exports, imports, employment, payrolls and earnings, etc., for 20 main classifications. These classifications follow as far as possible the census classification of industries and include besides, sections on construction and real estate, electric power and gas, employment conditions and wages, finance, trade (domestic and foreign), and transportation and communication.

The 3,000 series listed are compiled by 240 governmental departments, trade associations, private research agencies, and technical or trade magazines and papers.

The job is a splendid one and will be received with thanksgiving by statistics seekers. Considerable thought has apparently been given to the problem of making the check-list usable. The format of the tables and the classifications and subclassifications used make for quick and convenient reference.

A few minor criticisms come to mind, many of which are recognized by the editors in their introduction. The answer to most of them is the restraint imposed by spatial limits and the desire for reference convenience. It is in a wistful spirit, therefore, rather than a critical one, that these points are raised.

First is the fact that in the case of several Government departments, the check-list refers only to the compiling bureau and not to the publication itself. The worst, and thus of course not typical, example of this is the eighteen publications of the Bureau of Foreign and Domestic Commerce, which are allotted only one reference number.

Again, prices of periodicals and reports are not indicated. In view of the

heights which prices of some services have been known to reach, the question of price is at least pertinent.

For obvious reasons the directory omits data compiled by private agencies or associations when such data are available only to clients or members. And, succumbing to the emphasis on brevity, only original or compiling agencies are catalogued. Periodicals carrying desired data second-hand may in many instances be much more easily accessible than the report or press release of the compiling agency, particularly if that agency is located in another city. One notable exception is the *Survey of Current Business*, which the directory recognizes in every applicable instance by the addition of an asterisk to the reference number. From the liberal sprinkling of asterisks throughout the directory's 55 pages, it is possible to conclude that if one has the *Survey of Current Business* one is likely to get the largest possible footage of statistics per reference, for the *Survey* carries a majority of the series catalogued.

Finally, there is no way of telling from the directory whether a particular series listed is in actual values or amounts or has been converted into relatives or indices.

It is very probable that, after due consideration of alternatives, the present form and content were adopted as confining a maximum of conveniently accessible information in a minimum of space. It is pleasant to be able to report that the maximum of information and the minimum of space both seem to have been achieved.

EDWIN B. GEORGE

Dun & Bradstreet, Inc.

Expenses and Profits of Limited Price Variety Chains in 1936, by Malcolm P. McNair. Boston, Massachusetts: Harvard University. Publication of the Graduate School of Business Administration. Volume XXIV, Number 4. Bureau of Business Research, Bulletin Number 105. June, 1937. vi, 38 pp. $1.00.

This report analyzes the expenses and profits for 1936 of 33 limited-price variety chains operating 5,138 stores. These stores had aggregate sales of $815,000,000 and accounted for 92 per cent of this type of business in the United States. With this report the Bureau now has consecutive data on variety store operations for the six years beginning with 1931. Data are also available for 1929. Over 50 per cent of the sales of these stores were in apparel and accessories and household wares. Jewelry afforded the lowest sales volume.

The statistical summary of expenses and profits is made more effective with an interpretive analysis involving comparisons with department stores,

year-to-year trends, analyses of factors affecting margin and expense and relative profit performance. The explanatory note at the close of the report will be helpful to those interested in the accounting and statistical procedure. This study was made with the co-operation of the Limited Price Variety Stores Association and is of definite usefulness to enterprisers in the variety store field. Moreover, this record of retail performance is of interest to other chain distributors as well as to other types of retail enterprise.

Price limit continues to be an important problem. Adding higher price items minimizes the promotional appeal of the low fixed-price limits. If the attraction of a wider range of merchandise and prices will offset this disadvantage the study concludes that: (1) gross margins will be lower; (2) total cost of business as a percentage of sales will tend to be lower; and (3) net profit as a percentage of sales will be lower because the decrease in the total percentage will not be as great as the decrease in gross margin.

Some of the interesting observations and conclusions of this report are:

(1) Variety chain stores made a better showing during the depression than did department stores, partly because of the pulling power of their fixed price appeal. With the return of some prosperity, however, consumers tended to shift their patronage to stores selling high-price merchandise, causing variety stores not to gain in the same measure as some other retail types.

(2) Gross margins increased but slightly in 1936. By way of comparison, the gross margin percentage increase for department stores was greater. The report raises the question as to whether variety chains will be able to maintain gross margins of the 1933–36 level without leaving an opening for competitors to accomplish something comparable to the inroads of the super-market on the grocery chain.

(3) Aggregate total expense indicated a small percentage decline. Department stores were able to realize greater decreases in expenses with greater increase in sales volume. Wage and hour problems in 1937 suggest that it will be difficult for variety chains and other retailers to get the expense average below the 1936 figure. It is stated that variety chains must discover methods of increasing the productivity of labor so that increased output will support the high wage rate.

(4) Variety chain net profit in the narrow sense was just under 5 per cent of net sales. More variety chains earned some net profit in 1936 than did department stores.

(5) Salaries and wages and occupancy costs accounted for more than 80 per cent of the costs of doing business in 1936.

(6) Advertising, an important cost for many retailers, amounts to less than 2/10ths of 1 per cent of sales.

The report summarizes year-to-year trends which embrace previous studies. Reports from seven companies show that average sales per store in

1936 of $186,000 were lower than the average sales per store in 1927 and 1929 although higher than the 1932 figure.

Sixteen identical companies reported operating results for 1929, and 1931–36. There was no severe decline in gross margin percentage during the depression; and beginning in 1933 there were increases in gross margin percentages. Expenses reached a high peak in 1933, with slight declines in each of the three following years.

In analyzing factors affecting margin and expense the report considers differences in size of company, size of average store, rate of stock turn, amount of average sales, and differences in size of cities. (The median figures are more important in this analysis as they weigh equally the experience of each firm as a management unit.)

This analysis of margins and expense indicates within limits:

Those enterprises making a relatively high proportion of their sales in apparel and dry goods had lower gross margins than did the companies specializing in the nickle and dime business.

Transportation costs on incoming merchandise were high for small chains and companies with low stock turn rates and companies located in smaller cities.

Size of chain did not greatly affect total expenses. Firms with high stock turns, however, had relatively lower wage and salary expenses.

The optimum size of sales transaction lies somewhere above the low point of the typical nickel and dime business.

In short, profits were best for chains with a large sales volume, a large number of stores, high average sales volume per store, fast stock turn, low average amount of sales transaction, and stores located in cities above the smallest population groups.

Total payroll as a percentage of sales was high for companies with low sales volume, small number of stores, low average sales per store low stock turn rates, low average amount of sales transaction, and locations predominantly in towns and cities under 25,000.

Tenancy costs were highest as a percentage of sales for chains with large sales volume, large number of stores, high average sales per store, high rates of stock turn and 50 per cent or more of their stores in cities over 25,000.

One section of the report reviews the relation of store expense to overhead expense. This section offers the interesting comment that salaries of officers, buyers, superintendents, and other executive personnel were a much lower percentage of sales than the salaries of store managers.

In discussing relative profit performance the report concludes that the superior profit advantage of the nine chains with the highest rate of net profit lay both in their higher gross margins and in their lower percentages for total expenses.

KENNETH DAMERON

Ohio State University

Operating Results of Department and Specialty Stores in 1936, by Carl N. Schmalz. Boston, Massachusetts: Bureau of Business Research, Harvard University. Publication of the Graduate School of Business Administration. Volume XXIV, Number 3. May 1937. Bureau of Business Research Bulletin Number 104. vi, 38 pp. $2.50.

This series of annual reports on the margins, expenses, and profits of department and specialty stores is well known to most readers of the JOURNAL. In the September, 1936, issue, the two previous studies in the series were capably reviewed. Therefore, attention will now be directed to the changes which have been made in the present report, to the trends noted through an analysis of the 1936 data, and to the suggestions made to store executives.

The detailed treatment of year-to-year trends has been omitted. Many comparisons with previous years are made, however, in the summary and conclusions section. Although comparative data by years are not given in tables as previously, still the exposition furnishes an excellent picture of trends, and both space in the publication and time of the reader are conserved. Those who wish to work with data of other years can refer to previous reports. A new expense division has been added to the expense breakdown. It is "Percentages of Net Credit Sales." There are three subdivisions as follows: (1) pay roll: accounts receivable and credit; (2) losses from bad debts; (3) interest on accounts receivable. "The total of accounts receivable and credit pay roll, losses from bad debts, and interest on accounts receivable outstanding for the five groups of department stores with sales of $1,000,000 or more ranged from 3.45% to 2.8% of credit sales. For specialty stores with sales of $2,000,000 to $4,000,000 the total was smaller, 2.4%. Accounts receivable outstanding (averages of balances at the beginning and end of the year) typically were from 22% to 27% of credit sales for department stores, and from 18% to 21.8% for specialty stores."

Sales in both department and specialty stores continued to increase in 1936. In the ten groups of department stores studied, the increase ranged from 7.6 per cent to 13 per cent with larger increases in the larger stores. For department store business "the great depression is definitely a matter of history." Dollar sales in 1936 were roughly 16 per cent below the average level of 1929, but physical volume was 7 per cent above 1929 and but 2 per cent below the all-time high established in the first six months of 1931. Profits likewise increased markedly, occasioned largely by lower expense and by a higher maintained markup. The gross margins taken by the stores did not change appreciably, but they did not find it necessary to take as great markdowns, thus achieving a higher maintained markup. The expense percentage was lower as a result of increased volume without a proportionate increase in expense. The author notes that the 1936 pay roll was not influenced by union activity in the retail field but that higher pay roll costs may appear in 1937.

The suggestions made are largely in regard to the need of further study.

Problems occasioned by the depression are a thing of the past, but the older problems are still present and, perhaps, in an aggravated form. Among them are competition with other forms of retailing, a revision of service and service costs in conformance with consumer desires, employe relations, and the ever-present problem of making adjustments in anticipation of changes in business conditions. With department and specialty store business at high tide, executives should "get ready for the difficulties which lie ahead."

D. M. PHELPS

University of Michigan

The Physical Distribution of Fresh Fruits and Vegetables, by Edward A. Duddy and David A. Revzan. Chicago, Illinois: University of Chicago Press. Studies in Business Administration, Vol. VII, No. 2. 1937. ix, 92 pp. $1.00.

This monograph is divided into four parts: "Economic and Social Bases of the Commercial Fruit and Vegetable Industry," "The Growth of the Commercial Fruit and Vegetable Industry," "The Market Distribution of Fruits and Vegetables," and "The Chicago Wholesale Market for Fruits and Vegetables." Data going back as far as 1899 are given for the more important items (pp. 28–47). Reasons for the growth of the commercial traffic in these products are given (Chapter I), together with a short review of consumer attitudes (pp. 82–4) and the influence of the truck (pp. 78–82).

The main purpose of the study, however, is to show the origin and destination of the fresh fruit and vegetable industry, changes in movement, and over-all shifts in per capita consumption as measured primarily by commercial production or unloads, giving special attention to the Chicago market as a center for redistribution as well as consumption.

From the point of view of many different groups interested in such data, the most important figure in the marketing of any fresh fruit or vegetable is that of per capita consumption and, if possible, the trend in per capita consumption. The authors generally discard estimates of total production of the Bureau of Agricultural Economics, which "while corrected to exclude quantities produced but not harvested, necessarily include that part of the crop which is canned or dried, the culls or surplus used for by-product manufacture, and that part of the crop which was consumed locally and not shipped." Although total estimates alone are available for some of the crops, commercial figures are presented for the majority since 1918 and "are thus the best index of the growth of the industry" (p. 26).

Like total estimates, railroad car shipments are inadequate because "the record of rail shipments has ceased to be an adequate measure of the volume of movement of many commodities to wholesale markets since 1927 because of the inroads of the motor truck into the perishable freight business of the railroads" (pp. 26–7).

The authors wisely accept, as the best measure of the growth of the industry, per capita consumption, using, where possible, production data cor-

rected for imports and exports (p. 27). The question immediately arises, however, whom to include and whom to exclude under the head of "per capita." The authors use total population for staples and urban population for all others. The simplicity of this method is obvious; its soundness, however, may be questioned. Rural populations, according to Census statistics, include those living in towns of 2,499 people, to say nothing about smaller places, suburbs, and farming areas immediately adjacent to "cities" or "towns." For various reasons, stores—particularly chain stores—located in these regions handle most, if not all, kinds of fresh vegetables and fruits, even though the per capita consumption is undoubtedly lower. Racial characteristics, difference in incomes, age, sex, and possibly a number of other factors may have a decided bearing on the consumption of fresh vegetables. Such considerations would lead to a more refined result, figures which would be of more value to the local rather than to the national distributor, social scientist, dietician, and others interested in this subject. Per capita figures for the nation as a whole represent a start; breakdowns by trading regions must be made before they are of maximum commercial value.

As a step in this direction, regional (nine census divisions) breakdowns are given for carlot shipments of 18 fruits and vegetables to 66 markets, together with the origins of these same unloads. The presentation of these data naturally leads to the discussion of the deficit and surplus regions for these commodities, combined (Chapter III).

In discussing the Chicago market, the authors state that "in general, one may say that the commodities which have been brought closer to the market by a change in the method of transportation (talking about the motor truck) are those which have a wide range of adaptability to soil and climate." The truck has built up production nearby of those crops which can be locally produced (p. 79).

With less assurance, the authors find that consumer preferences have also changed the production pattern. A swing from the Wisconsin to the Idaho potato is cited. A desire for a longer season broadens the producing area serving any large city. They add: " . . . the geographical pattern of supply of fruits and vegetables for the Chicago market is most unstable. A change in price level or a revision of freight rates may easily result in rearrangement of the major sources of supply as far as the Chicago market is concerned" (p. 84).

The authors conclude:

> "It should finally be noticed that, though per capita consumption of potatoes and apples is declining, these two bulk large in number of pounds consumed annually. Oranges have displaced apples in this respect. As annual consumption figures, the per capitas of the remaining commodities must be considered low enough to allow for still further expansion consistent with favorable price conditions and the expressed preference of the consumer" (p. 92).

The value of this excellent monograph lies not so much in the per capita

consumption figures as in the attempt to arrive at some practical data. In the field of distribution there are still too many general tomes, describing institutions, functions, and commodities, and entirely too few short analytical monographs. Consumption data of real value can only be obtained when students in the field carefully check every figure, analyze every idea, and draw no general conclusions. Authors Duddy and Revzan have taken a forward step in this direction with the publication of *The Physical Distribution of Fresh Fruits and Vegetables.*

WILFORD L. WHITE

Bureau of Foreign and Domestic Commerce

The Objective Rate Plan for Reducing the Price of Residential Electricity, by William F. Kennedy. New York: Columbia University Press. 1937. x, 83 pp. $1.25.

The objective rate plan was formulated by the Commonwealth and Southern Corporation and was first introduced by its subsidiary, the Alabama Power Company, on October 1, 1933. The principles of the plan have subsequently been adopted by 56 other electric utilities operating under the jurisdiction of 28 state commissions. This plan is the most recent and promising device to encourage increased consumption of electric energy, thus making possible lower unit costs and lower rates. Its principal vogue has thus far been in the residential field.

The objective rate plan provides for two simultaneously effective rate schedules: the immediate rate, a schedule designed to protect the company from the loss of revenue that would occur if rates were reduced without a corresponding increase in the sale of electricity; and the objective rate, a lower rate which applies to those customers whose consumption is increased by specified amounts over the consumption of a base period. As applied by the subsidiaries of the Commonwealth and Southern—"Base bills are determined for each consumer by applying the immediate rate to the consumer's actual consumption in each of the twelve months preceding the inauguration of the plan. Whenever a bill under the immediate rate equals or is less than the consumer's base bill, the immediate rate applies. Whenever a bill under the objective rate exceeds the base bill, the objective rate applies. Whenever the immediate rate results in a bill greater than the base bill, and whenever the objective rate results in a bill less than the base bill, the base bill applies."

Mr. Kennedy finds the origin of the plan in the dilemma presented by demands for rate reductions during the depression, when the loss of industrial load had already imposed serious shrinkages in total revenues and when rate reductions not offset by proportionate increases in sales were financially dangerous to the utilities. The immediate occasion for the inauguration of the plan was supplied by the imminent competition of the T.V.A. and by a commission order requiring the reduction of rates to domestic consumers.

The more general characteristics of the 56 operating plans are described; but the absence of data for the more recently installed plans compelled the restriction of the analysis of the results under the plans to six southern operating companies of the Commonwealth and Southern Corporation. Although economic recovery, changes from less desirable rate forms to promotional block schedules, rate reductions, and aggressive campaigns for the sale of appliance are all recognized as disturbing factors, the objective rate plan is reasonably credited with achieving large gains in the sales of domestic electricity, the average annual consumption per residential customer exceeding 1,000 kilowatt hours, and making possible a reduction of the average charge from 5 to 3½ cents per kilowatt hour for domestic electricity. The plan was successful in protecting the absolute level of residential revenues, and, after a first-year decline in revenues per customer, this index also showed steady improvement. The discrimination implicit in the plan—when two customers having the same total consumption pay different bills if one has a smaller base use—is held to be justified by the larger benefits to the entire body of consumers.

Though his study is necessarily limited by the availability of data, Mr. Kennedy's presentation, commendable for its conciseness and clarity, should aid utility executives, regulatory authorities, and consumers to appreciate the potentialities of the objective rate plan as a means of protecting utility revenues while stimulating that increased utilization of service which can bring lower costs to the companies and lower rates for consumers.

IRSTON R. BARNES

Yale University

A Study of Fluid Milk Prices, by John M. Cassels. Cambridge, Massachusetts: Harvard University Press. Harvard Economic Studies, Volume LIV. 1937. xxvii, 303 pp. $4.00.

It is seventeen years since Clyde L. King, who has just passed away, published his pioneer monograph, "The Price of Milk." Comparison of his conclusions, based on first-hand experience in milk arbitration, with the conclusions reached by John M. Cassels in his comprehensive appraisal of milk prices, is a good index of the economic and statistical progress made in this field in the intervening decade and a half. Perhaps more than in any other monographic study of an individual commodity yet published, Dr. Cassels has blended theoretical economic analysis with statistical appraisal of the significance of that analysis. If the result is not completely satisfying, it is because at many points in the field statistical studies are as yet only suggestive of the true relations, and hence definite conclusions on many points have to be left in abeyance.

The most stimulating parts of the book from the point of view of the professional price analyst are the first five chapters. In these chapters the neoclassical economic analysis is applied with skill and discrimination to the

exceedingly complex problem of the interrelationships of prices among the several products into which milk may be made, the interrelationships of producers', market, and retail prices, and the production reactions. The theoretical analysis of the geographic distribution of the "disposal response," or use of the milk for various purposes in the areas around one or more markets, is a distinctive contribution to the theory of the geography of prices. Much of this analysis has already been published in various professional journals, but it is here brought together in clear-cut and compact shape and will prove significant not only to students of milk prices as such but also to students of general economic theory.

The analysis of the conditions with respect to the elasticities of demand for fluid milk and other products which make price discrimination possible is also well developed. The institutions that have developed in the field, particularly cooperative marketing organizations and the pricing plans and bargaining methods used by them, are clearly and coherently related to this analysis.

The next portion of the book deals with the statistics of the industry. In describing the geographic picture of production and consumption, some unique charts are introduced which show the balance of production, disposal, and consumption as between manufactured products and fluid milk. Many statisticians will feel that these charts show too much in a single diagram and that a series of charts to show the relations depicted would be more intelligible to the average reader.

The balance of the book is devoted to an examination of the statistical evidence on the demand and supply of milk and its products; and on the geographic development of the industry, especially in the northeastern markets and in New England; in the light of the hypothesis developed in the first part. This analysis shows in general that the demand for fluid milk is very inelastic, that dealers' margins and transportation rates tend to be inflexible, resulting in even less elasticity of demand in the price to the producer than in retail prices; that the response of milk production to prices offered shows some evidence of responding according to theory but with conflicting results for different periods; and that the geographic distribution of marketing areas and production zones follows in general that to be expected from the theoretical analysis, though with areas by no means as precisely separated as indicated by the theory. Under the study of price relations two interesting maps of the geography of milk prices and butter prices are presented, and evidence is developed to show the existence of a consistent national price structure for butter and other manufactured products and a less consistent national price structure for fluid milk.

Finally the actual price for fluid milk in the various city markets is compared with the theoretical price based on the price of butter and cream at the edge of those markets, and the conclusion is reached that the existence of farmers cooperative organizations and discriminative pricing systems has resulted in maintenance of fluid milk prices in those markets materially

above the price that would have prevailed under free competition, with the extent of the monopoly gain in different markets correlated with the strength and vigor of the several cooperative marketing organizations.

Dr. Cassels states that the study has been little changed since it was submitted as a doctor's thesis in 1934. This is unfortunate both in that the statistical data are not carried beyond early 1933 and in that the text still includes some details of statistical compilation which, for general readers, might better have been relegated to the appendix. Even so, the writing is clear and concise. Even if the data had been carried down to date, the general conclusions would probably have been little changed.

Two details of technical statistics may be noted. In discussing an earlier study where one variable was correlated with the values of another variable for 12 months earlier, Cassels says that this should be described by saying the earlier variable was "advanced" 12 months rather than saying it was "lagged" 12 months. "Lag," according to the dictionary, means "to fall behind." Obviously the production response lags behind the price. If the price is to be placed at the same period of the resulting production response, it must then be "lagged" to the same extent. Where the value of a given variable is used for a period materially behind its true period, it is thus, I believe, better terminology to refer to the value as a "lagged value," since it is moved to a date subsequent to its actual period.

In his examination of statistical analyses of production responses, Dr. Cassels recalculates a study of Vermont milk production which had been made by the present reviewer. The original study covered the period 1917 to 1925. In the new study, Dr. Cassels finds that factors which showed a significant relation to production before showed no significant relation in the period he examines, 1921 to 1931. The years 1917 to 1920, when there were marked variations in both production and prices, were eliminated from this test "in view of the abnormal conditions prevailing between 1917 and 1920." In part, the divergence of results may be due to the improvements in technique which Dr. Cassels introduces and to a bias in calculation which he believes he has found in the earlier study. It is not surprising, however, that economic forces which explain changes in years of violent change, as during and shortly after the war, should prove less significant in years of relatively stable production. When the data for the recent depression and recovery period can be included in the study, it may be found that production during this last "abnormal period" responded to price stimuli just as it had during the earlier period that Dr. Cassels excluded from consideration.

As a whole this is an excellent piece of work, covering both the theoretical and practical economic situation for a given commodity in well-rounded style, setting up hypotheses for the statistical examination carefully and critically, and checking back the extent of agreement between the statistical data and the economic hypotheses. It reflects credit not only on the author but also on John D. Black, whom Dr. Cassels credits for the guid-

ance of the project. The general conclusions reached, that milk and dairy products show as a whole the existence of a competetive market except in fluid milk areas where cooperative marketing organizations and pricing plans have intervened, and that in those cases there have been important monopoly gains, seem well substantiated. No attempt is made to discuss the ethics of these monopoly gains or to consider whether consumers benefit, in the long run, from paying them.

This is an important book and one which will be useful to many students in many fields. It is to be hoped that similar comprehensive analyses of production and prices will become available in the years ahead for both agricultural and industrial products. To the extent they do, they will change the teaching of economics in the direction of realism and objectivity and provide a far firmer scientific basis for the economic art.

MORDECAI EZEKIEL

Washington, D. C.

Butter and Oleomargarine: An Analysis of Competing Commodities, by W. R. Pabst, Jr. New York: Columbia University Press. London: P. S. King & Son, Ltd. 1937. Studies in History, Economics and Public Law. Edited by the Faculty of Political Science of Columbia University. Number 427. 112 pp. $1.50.

This book gives a brief summary of the development of the butter and oleomargarine industries in the United States, a survey of oleomargarine legislation, a theoretical statement of the interrelationships of the two commodities, and a statistical study of the interrelationships based on annual data for the period 1921–34. This background gives a basis for appraising the possible effects of recent proposals for oleomargarine legislation, if enacted.

Chapter I gives a history of the industries, with the emphasis on the principal technological developments that have affected the production of butter and oleomargarine. It is stated in this chapter that "the United States standard for fluid milk is that it should contain 3.5 per cent by weight of butterfat." There are no Federal standards for the butterfat content of milk. The Bureau of Agricultural Economics estimates that the average butterfat content of all milk produced in the United States is about 3.93 per cent and that the average test of milk used in the production of butter is somewhat higher than the average. It takes about 21 pounds of milk to make a pound of butter.

Chapter II is an excellent summary of oleomargarine legislation written from an economic point of view. The chapter is entitled "Restraint of Competition between Butter and Oleomargarine."

Objections could be raised to the statement that butter and oleomargarine are similar products. The similarity or difference depends upon the criteria by which they are judged.

In the statistical analysis, data on consumption of butter ("apparent disappearance") are used. The author uses consumption of butter as an

independent and as a dependent variable in determining the interrelationship between prices and consumption of butter and oleomargarine, time, and per capita income.

In stating the causal relationship between these factors, there are some objections to using butter consumption as an independent variable. The year-to-year variations in butter consumption ("apparent disappearance") are due primarily to variations in butter production. In the 14-year period 1921 to 1934 there were 9 years in which consumption differed from production by less than 1 per cent and 3 years in which the difference was between 1 and 2 per cent. In 1933 consumption was 4.1 per cent less than production, and in 1934 consumption was 2.6 per cent larger than production. These differences in 1933 and 1934 were due in large part to the Government purchases of butter in the last 5 months of 1933 that were put in storage and distributed for relief in the first half of 1934.

There would be some justification for omitting the years 1933 and 1934 from the analysis because of the effect of Government purchases.

Because of the close relationship between the volume of production and the volume of consumption of butter, it would be more accurate in stating the causal relationships to think of butter production as the independent variable and butter consumption as being in very close adjustment to production, on an annual basis.

It is suggested on page 76 that, when fluid milk consumption decreases in times of depression, butter production tends to increase because of the greater volume of "surplus milk" diverted to butter production. This is, of course, true in fluid milk markets. In the Corn Belt, where the major proportion of the butter is produced and where relatively little milk is used for fluid use, dairying competes with the production of hogs and cattle. Studies made in the Bureau of Agricultural Economics indicate that in Iowa the major changes in butter production are due to changes in the relationship between butterfat prices and hog prices. High prices of butterfat in relation to hogs stimulate butter production. Feed supplies and pasture conditions also affect butter production. Changes in consumption of fluid milk do affect butter production, but the major fluctuations in butter production in the past 15 years have been due to other factors.

The last chapter of the book is an analysis of the proposals for further oleomargarine legislation proposed by the National Cooperative Milk Producers' Federation.

E. E. VIAL

Bureau of Agricultural Economics
U. S. Department of Agriculture

The Theory of Statistical Inference, 1936–1937. Lectures by S. S. Wilks, Princeton University. Ann Arbor, Michigan. Planographed by Edward Brothers. 1937. iii, 106 pp. $1.50.

These lectures present the main notions involved in the theory of statistical inference in a clear and elegant manner.

The elements of probability theory that are given in Chapter I are essential as a foundation for the basic principles and theorems of sampling theory. For the purposes of the theory of statistics, *probability* is regarded as a concept which depends for its meaning on aggregates of phenomena or repeated events. The aggregates are regarded as unlimited sequences of events and are called "statistical universes" or "populations."

Of special interest from a logical point of view is the explicit statement of certain assumptions regarding populations from which the usual laws of probability can be obtained as consequences of certain operations on the populations. In particular, assumptions are stated which underlie the notion of *probability density*. Next, the concepts of mean and variance are presented, and several important theorems regarding mean values and variance are developed. The manner in which the rules for combining probabilities may be regarded as operations on populations is discussed in terms of the following operations on populations: (1) random selection, (2) mixture, (3) partition, (4) conjunction.

Chapter II deals with general notions of sampling theory. This includes an elegant development of the law of large numbers based on Tchebycheff's inequality; the normal approximations to the binomial and multinomial distributions; the geometrical development of the χ^2 distribution, and the Poisson distribution. The chapter includes also the development of various methods for determining the sampling distributions of certain statistics. These include the determinations by characteristic functions, by moment equations, and by geometrical devices.

The chapter on the estimation of population parameters starts with the definition of a *statistic* as a function of the variates supplied by a sample for estimating a population parameter. The meanings of the three fundamental criteria of a statistic—consistency, efficiency, and sufficiency—are presented.

The Pearson and the Gram-Charlier systems of frequency curves are considered with special reference to the consistency of their parameters estimated by the method of moments. The method of maximum likelihood for determining optimum estimates is developed and applied to a few examples, where, by an optimum estimate, we mean a statistic that satisfies the three criteria mentioned above. The chapter closes with an excellent treatment of the estimations of parameters of the regression functions including the determination of sampling errors.

Up to this point, the lectures have considered deductive problems, that is, they have been concerned with methods of finding distributions of statistical functions computed from samples drawn from populations whose distributions are specified both with respect to form and parameters. But, from the standpoint of statistical inference, the most direct and crucial problems consist in arguing from samples and their statistics back to populations and their parameters. This class of problems is dealt with in the last two chapters. In this class of problems, conclusions are usually stated in terms of probabilities rather than in certainties. It is in this connection that con-

troversies have arisen in the so-called inverse probability theory. In the present lectures the controversial questions centering around assuming a constant distribution of probabilities in the initial situation are avoided and the method of fiducial inference initiated by R. A. Fisher is developed in an interesting manner. This method serves mainly to test a hypothesis for rejection under the assumption that it is true. The final chapter deals with the Neyman-Pearson theory, which deals not only with criteria for the rejection of hypotheses assumed to be true but also with the rejection or acceptance of other types of hypothesis such as the probability of the acceptance of hypothesis which is false.

The illustrative examples are well chosen and serve to make the lectures more readable at many points than they would otherwise be.

H. L. RIETZ

University of Iowa

The Mathematical Problem of the Price Index, by J. K. Montgomery. London: P. S. King & Son, Ltd. 1937. 74 pp. 6*s*. 0*d*.

This little book of only 74 pages, packed with mathematical formulae, may well be considered as a major contribution to the *theory* of index numbers.

My chief adverse criticism is the use of the word "the" rather than "a" in the title; for there are many other and fundamental mathematical problems of price indexes besides the particular one to which Mr. Montgomery gives his sole attention.

Another criticism is that he seems unable to crystallize "the" problem into a simple and clear-cut statement in words. This he admits. On the first page he says: "The following statement of what the writer puts forward, without claiming any originality for it, as the most satisfactory conception of the price index can hardly be called a definition, as he proceeds by first expressing the conception in vague terms and afterwards trying to give a more precise meaning to those terms."

On the next page he says: "Comparing the commodities in the given year with the commodities in the base year, we note that both prices and quantities have changed. The aggregate value is partly due to the changes in price and partly to the changes in quantity."

On page 8 he says: "We have now to make clear what we mean by 'the change in the aggregate value due to the changes in price' and 'the change in the aggregate value due to the changes in quantity'."

The author reaches precise results in mathematical terms but seems never able to state the meaning of "due to . . . " in words. The nearest approach seems to be on pages 18, 19, 20, where he mixes words and formulae as follows:

"In the equation [expressing a product of factors as equal to a sum of terms] ..... let ..... where ..... is such that adding ..... contributes as much to the sum .....

as multiplying ..... contributes to the product .... Hence we may say that ..... represents the change (measured as a difference) in ..... *due to the change* from ..... to ....., and so on. Thus we can transform the difference ....., which is the increase of .... *due to the change* of ..... to ..... and so on, into the sum of a series of terms ..... of which ..... represents the increase of ..... *due to the change of* ..... to ..... (simultaneously with the change of ..... to ..... and so on). ..... represents the increase of ..... *due to the change of* ..... to ..... (simultaneously with the other changes) and so on." [The italics are the author's.]

There are not, in the entire book, any other passages which could be quoted in this review as showing the meaning of the problem of the book; and the passages just quoted are from three separate pages interspersed with formulae, occupying most of the space, which formulae, if quoted here, without their background in the preceding pages, would be unintelligible.

It will be seen that Mr. Montgomery regards the problem of index numbers as one of translating a sum such as Σpq into a product such as PQ.

The author's problem is at bottom substantially the same as that involved in the problem of logarithms, by which an "arithmetical" series of numbers succeeding each other by equal differences corresponds to a "geometrical" series of numbers succeeding each other by equal ratios.

Consequently the author's result involves logarithms and exponents. If the prices in the base year are p_0, p_0', p_0''—and the associated quantities (multipliers, often miscalled "weights") are q_0, q_0', q_0''—the author's new index number, P_{01}, of prices is (page 32):

$$P_{01} = \left(\frac{\Sigma p_1 q_1}{\Sigma p_0 q_0}\right) \frac{\Sigma(p_1 q_1 - p_0 q_0)\{[\log p_1/p_0]/\log (p_1 q_1/p_0 q_0)\}}{\Sigma(p_1 q_1 - p_0 q_0)}$$

with a corresponding formula for Q_{01}.

This result is a matter of great theoretical interest for all students of the mathematical theory of index numbers. Like the curious formula invented by the late Professor Allen Young,[1] it cannot be classified under any of the classifications into which fall all the nearly 200 formulae discussed in my *Making of Index Numbers*.

It suggests an entirely new class built around the idea of operating on:

$$\frac{\Sigma p_1 q_1}{\Sigma p_0 q_0}.$$

Mr. Montgomery compares his formula with what I called the "ideal" formula, namely:

$$P_{01} = \sqrt{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \cdot \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}}.$$

[1] See "Fisher's The Making of Index Numbers," *The Quarterly Journal of Economics*, February 1923.

This may evidently be so written as to contain, more explicitly, the magnitude $\Sigma p_1q_1/\Sigma p_0q_0$ with which Mr. Montgomery starts.

He points out that his index lies between the two limits $\Sigma p_1q_0/\Sigma p_0q_0$ and $\Sigma p_1q_1/\Sigma p_0q_1$, and comments:

"This explains why Professor Irving Fisher's 'ideal' formulae . . . give a very good approximation . . . since they are the geometrical means of the limits between which P_{01} and Q_{01} must lie."

For the one case which he works out arithmetically, his formula gives 161.74 and the ideal, 161.56, the difference being .18 or almost exactly one-tenth of one per cent.

Mr. Montgomery's formula fulfills the important "time-reversal test" as well as the "factor-reversal test." He does not discuss the other tests except the circular test which neither his formula nor the "ideal" fulfills—though, theoretically, that failure both he and I find to be a virtue rather than a defect.

Mr. Montgomery's study may conceivably lead the way to other interesting results in index number theory. But, for the present, his formula is a "tour de force." It is not usable in practice, requiring as it does far more laborious calculations even than the "ideal" formula, which, in its turn, is seldom of practical use since the extra refinement it yields is seldom worth the extra calculations required.

From a practical standpoint the simple aggregative $\Sigma p_1q_0/\Sigma p_0q_0$, to which Walsh gave the name of "Laspeyres' formula" since Laspeyre seems to have been the first to use it (in 1864), probably gives as great accuracy as is usually needed.

This formula is gradually winning its way and replacing all other weighted formulae, while, among unweighted formulae, the simple geometric is apparently superseding the simple arithmetic, for reasons described in my book.

Thus theory and practice are far apart. Mr. Montgomery has definitely contributed to the former but not the latter.

IRVING FISHER

Yale University

On the Statistical Theory of Errors, by W. Edwards Deming and Raymond T. Birge. Washington, D. C.: The Graduate School of the United States Department of Agriculture. (Reprinted from *Reviews of Modern Physics*, July 1937, with additional notes dated 1937.) Pp. 119–161. 35 cents.

It is very gratifying to see this article made available for more general distribution. Written in a remarkably clear and concise style, it treats most of the important phases of the modern theory of errors.

After an introduction, which sketches the background of the subject, the authors proceed to the development and description of the frequency distributions of the statistics u (deviation of sample mean from population mean), s (sample standard deviation), and z $(=u/s)$, in samples from a

normal population. The use of these distributions in making the ordinary tests of hypotheses about the parent population is then explained—tests which determine the probability that the given sample could have been drawn from a population having a proposed mean and a proposed standard deviation. In this connection, the question of fiducially related values of σ (population standard deviation) and s is discussed.

In dealing with the problem of estimation, the writers consider the method of maximum likelihood, empirical estimates, and the posterior method, making quite clear the underlying assumptions of the different methods. The important question of the reliability of various estimates is carefully treated.

To be commended is the placing of a complete list of symbols, with explanations, at the beginning of the article.

The only adverse criticism concerns the typography, which, although in general excellent, is somewhat marred by the columnar arrangement. There is a frequent shifting, when a long formula occurs, from two columns to one and back again. This gives a displeasing appearance to the page and is also slightly confusing to the reader.

On the whole the monograph is excellent and its study is earnestly to be recommended to those desiring an introduction to the modern statistical theory of errors, or those seeking to clarify their ideas on this subject.

PAUL R. RIDER

Washington University
Saint Louis

Statistical Analyses of Industrial Property Retirements, by Robley Winfrey. Ames, Iowa: Iowa State College. Publication of the Iowa Engineering Experiment Station, Bulletin Number 125. December, 1935. 176 pp. Free.

In this exhaustive study of methods of estimating the service life of physical property, five different procedures are considered for assembling data for constructing survivor curves from which the distribution of length of service life can be determined. These procedures are devised so as to be applicable to the following most commonly used types of records which are kept regarding the installation and retirement of units of property:

(1) Records showing only the number of units retired during a given year or series of years, together with the age of each unit at retirement.
(2) Records in which the number of units placed in service during a given year (or some other period) is known, together with the number of these units remaining in service at successive later observation dates.
(3) Records in which an original group is too small to be very reliable, or when retirements do not produce a satisfactory survivor curve.
(4) Records in which the number of units in a group of units placed in service during each of several years is known, together with the number of units remaining in each group at successive later observation dates.

(5) Records giving the number of units retired during the period of observation and their ages at retirement and the number of units in service at the beginning of the observation period and their ages.

The five procedures devised by the author are applied to many varieties of industrial property, including gas meters, telephone poles, distribution transformers, railroad boxcars, trestles, crossties, etc. From a consideration of 176 survivor curves, 18 typical survivor curves and their mathematical equations are developed. From each of the survivor curves are also derived the curve of probable life (of units surviving at a given age) and the frequency curve of length of life. The author has used Pearson's curves and Gram-Charlier series for fitting his frequency distributions and the Gompertz-Makeham function for fitting the survivor curves. The technical operations and data involved in fitting these curves are given in three detailed appendices.

This study is rather well organized and has been made with care rivaling that used in many human mortality studies. A noteworthy feature is a well-defined terminology which makes it easy to follow exactly what the author has done. The bulletin embodies the results of laborious calculations, many of which are carried to seven and eight decimal places. This appears somewhat unnecessary in some cases in view of the fact that some of the samples have less than 100 observations in them. In other cases, however, in which 100,000 or more units are available, there is some justification for the more refined calculations.

There are various complicating factors which are not considered by the author, the main ones being salvage value, obsolescence, and improvement of quality of equipment. His methods, however, should prove useful in arriving at a more precise system of accounting for depreciation of physical equipment that is not significantly affected by these factors during its lifetime. More specifically, the procedures should be valuable to those public and private enterprises in which many similar units of equipment are used.

S. S. WILKS

Princeton University

Mathematics of Finance, by D. H. Mackenzie. New York & London. McGraw-Hill Book Co., Inc. First Edition. 1937. ix, 313 pp. Including *Compound Interest and Annuity Tables*, by F. C. Kent and M. E. Kent. First Edition, Seventh Impression. 1926. viii, 214 pp. $3.75.

The subjects treated are those usually found in textbooks on business mathematics. Somewhat off the beaten path and highly commendable are Chapter I presenting the "Economic and Legal Aspects of Interest" and two Appendices devoted to practical applications of amortization.

The minimum essentials of algebra are given in the first two chapters. The presentation of logarithms leaves considerable to be desired. The discussion on page 37 "Finding the Logarithm of a Negative Quantity" is unnecessary and only serves to complicate the use of logarithms for the stu-

dent. The complication reappears throughout the book wherever the term of an annuity is found with the aid of logarithms.

The development of simple and compound interest is on the whole adequate but is marred at several points by loose wording. Particularly noticeable is the failure to distinguish "number of conversion periods" and "length of conversion period" at the beginning of Chapter V. On page 70 the author appears not to realize that straight-line interpolation in the compound interest table for fractions of a conversion period is the equivalent of computing simple interest for the fractional part of a period. The use here and elsewhere in the book of the expression "If interest is compounded" meaning "If interest is compounded at intervals of less than one year or one payment period" is confusing to the reviewer. Perhaps it will not be found so by others. Equation of Value is discussed entirely as a problem in compound interest, whereas in practice simple interest for short periods of time is used more often than compound interest.

The explanation of the principles of annuities, which requires 106 pages, is quite unique. The author states:

> There are seven general cases of annuity computations each of which requires a different equation for the solution:
>
> 1. Payments annually—interest annually.
> 2. Payments annually—interest compounded.
> 3. Payments p times a year—interest annually.
> 4. Payments p times a year—interest compounded.
> 5. Payments p times a year—interest compounded, but $m = p$.
> 6. Payments at intervals greater than 1 year—interest annually.
> 7. Payments at intervals greater than 1 year—interest compounded.

Each of these seven cases is illustrated for the finding of each of the terms of the annuity equation for accumulation and present value of terminal annuities, and annuities due. These examples, which are intended to be the feature of the book, will prove to be its besetting sin, because students in solving problems will thumb the pages of the book in search of a similar illustration instead of trying to analyze the conditions of their problems. The equation of case 4 can, of course, be used to solve any annuity problem, if the symbols are properly defined. The development of six variations of the equation as separate cases introduces an atmosphere of complexity into the subject of annuities which is unwarranted.

Amortization of debts and the accumulation of sinking funds is well presented, except for the omission of the case of amortization in which the time for the debt to be paid is unknown. The treatment of bonds is somewhat incomplete and is marred by an unfortunate error in computing the "and interest" value of a bond bought between coupon dates. The accrued interest at the market rate instead of the coupon rate is added to the "flat" value instead of being subtracted from it to get the "and interest" value. The symbol $v_{\overline{n}|i}$ for $(1+i)^{-n}$ is used in the bond formula without explanation but appears at no other place in the book.

The chapters devoted to insurance are the best presentation in the book.

The explanation of the different types of insurance and the computation of single and annual premiums for simple examples prior to the introduction of the commutation notation is commendable as a teaching device.

The value of the book is greatly enhanced by the inclusion of the Kent 10 place tables of the interest and annuity functions.

M. A. BRUMBAUGH

University of Buffalo

Business Statistics, by George R. Davies and Dale Yoder. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. 1937. vii, 548 pp. $3.50.

Business men and students of statistics who are interested in the business point of view will welcome this book as a step forward in the business textbook field. The purpose of the book as expressed in the preface is a very desirable one—that of presenting statistical techniques in such a way that the business man and the student may know both the application and its limitations.

The student may indeed obtain a good knowledge of statistical method from this textbook. The description of methods throughout is presented in a clear-cut, straightforward style. The illustrative problems are sufficiently simple to make it as easy as possible for the student to grasp. At the same time, the illustrations are taken from actual social or business setups.

The problems presented at the end of each chapter are in themselves intelligent, well thought out questions. They illustrate, however, the chief weakness of the book. They will not stand on their own merit. Unless the teacher of this book uses it with ingenuity, it is no better than any other run-of-the-mill textbook on statistics. For example, on page 271 are problems on time series analysis. Problem 2 presents freight car loadings by quarters from 1923 through 1930. The student is asked to prepare a time series analysis of the data. Such an analysis is of doubtful value to most businesses. The problem is not one which will arouse much interest on the part of the student. In other words, it is entirely up to the instructor as to whether or not the student will derive any practical value from such a problem.

The second weakness of the book is connected closely with the weakness of the problems. It is disappointing to read a book entitled *Business Statistics* and find that only one chapter is devoted to a discussion of the actual application of statistical analysis to business problems. Granted, the student must first have a working knowledge of his tools. He can get this from *Business Statistics*. After acquiring this knowledge, however, he wants to know where to use each tool or combination of tools. An expansion of chapter ten would be desirable. A discussion after each chapter showing fields of business where particular methods are applicable would have strengthened the book from the business point of view even more.

FRANCES V. SCOTT

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Harvard University

Statistical Tables: Their Structure and Use, by Helen M. Walker and Walter N. Durost. New York: Bureau of Publications, Teachers College, Columbia University. 1936. v, 76 pp. $1.60.

This is a practical, small but nevertheless inclusive, book for the aid, primarily, of students doing educational research. Its usefulness, however, is not limited to students of educational research, although the reader in other fields will find all too few of the concrete examples selected from his specialty.

It is not a dry compendium of rules and injunctions—though the product gives evidence of a systematic long-time collection of these—but essays rather to present table-making as a psychological enterprise, an attempt to motivate the reader of a statistical report "to see my facts as I see them." Even a technically correct table may be lacking in reading comprehension. A title, for example, may give emphasis to the important idea or even omit it, and the mechanical arrangement of a table may facilitate or retard the comprehension and the extraction of the intended relationships and comparisons. The authors recognize that "there are still intelligent people who make a practice of skipping tables in their reading . . . "

The casual reader will find the going a little difficult because so much has been condensed into so few pages and because so many backward and forward page references are necessitated by using a limited number of tables in one section of the book for a goodly proportion of the total illustrations.

The authors have done a valuable and much-needed service in attempting to standardize table construction. With this standardization the reviewer in the main heartily agrees. He cannot, however, give his personal sanction to the use of Roman numerals for table numbers even "when there are twenty-five or fewer tables," nor to the publication at the *top* of an intercorrelation table of the means, standard deviations, and, presumably, the populations, reliability coefficients, and the like. He is sympathetic with the expressed wish that publishing houses could be induced to put in a supply of special one-character matrices for certain much-used complex statistical symbols. [Perhaps that is a function, for the future, of our Association?] Such symbols, in the reviewer's opinion, should be extended to include one-digit symbols for publishing coded original data which would reduce the publishing costs to such a point that graduate colleges might require publication of original data in all dissertations. This practice would facilitate checking, make the author more-than-usually-responsible for his work, allow reworking by alternative methods, and permit a newly discovered formula to be applied quickly to established data with known constants for comparisons of efficiency or of methods. The authors of the present volume have gone but little into the possibilities of such "general purpose" tables but rather have devoted most of their space to derived or "special purpose" tables.

The reviewer ventures to predict that, stimulated by the appearance of this volume, the topic of standardization of tables will be expanded in the near future. The fact is that statistics is a language and as such has a psychology as well as a mathematics. It is an artificial languge and would be more than usually amenable to useful standardization by appointed representatives of the practicing profession.

This little text will be a friend in need for the student writing his first research report; and it will be worth a reading by all who make tables. Until such time as the Association gives attention to the matter of standardization of table-making practices, as has the engineering fraternity in the matter of graphic representation, it will take its rightful place in the research student's three-foot shelf of practical reference works.

HERBERT A. TOOPS

The Ohio State University

Middletown in Transition, A Study in Cultural Conflicts, by Robert S. Lynd and Helen Merrell Lynd. New York: Harcourt, Brace and Company. 1937. xviii, 604 pp. $5.00.

It would be gratuitous to enter into an extended discussion of the contents of a work following the same general plan and subject matter as its well-known predecessor of 10 years ago. Suffice it is to say that this is a re-survey of the same middle-western city covered by the same authors' previous volume. As such, the present volume covers the period of the depression and gives an illuminating account of its impact upon various aspects of the community's life. Its favorable reception is not only a recognition of its excellence as a monograph in contemporary anthropology but is also a sort of index to the present stage of development of sociology. This stage (as represented by this volume and its predecessor) is far beyond that of the sociological novel, and the literature of muckraking, moralizing, and reform. On the other hand, sociologists have not yet become generally concerned with the problem of generalizing illuminating incidents, anecdotes, and case studies into a system of principles or laws accompanied by the more careful reservations and restrictions as to the conditions under which stated sequences and correlations may be expected to occur and the degree of probability of their occurrence under these conditions. Signs of the transition toward this latter stage are, however, apparent in the volume under review as contrasted, for example, with its predecessor. Thus, there is, if my impressions are correct, in the present volume, much more attention to the problems of sampling, the quantitative corroboration of impressions, and a constant recognition of possible distortions resulting from the methods employed. At the same time it retains the literary flavor, the rounded picture, and the "life" and "reality," as we fondly designate those characteristics which correspond to our sociological stereotypes.

The above classification of the volume in the series of stages through

which the social sciences are likely to pass is in no sense a reflection upon the quality of this volume or upon the superlative competence of the authors. Numerous imitations have appeared on the market since the success of the first *Middletown*, but the Lynds easily retain their lead in the present volume. *Middletown in Transition* will doubtless remain as a classic of its type. Nor is the value of this type of sociological literature to be minimized. It has a vast influence in gradually habituating students, not to mention the public, to the idea of taking a relatively objective view of the community and the social order in general. This is a very important function. It provides, furthermore, a wealth of hypotheses for testing by the more rigorous scientific techniques. What could be more valuable, for example, in the construction of an attitude test designed to determine the actual frequency and intensity of the beliefs constituting "The Middletown Spirit" (Chapter XII), than the list of more than a hundred of such "values" sensed by the authors from "the press, and the civic clubs, and in the folk talk in the streets and about the family dinner table"? The perspicacity of the artist in sensing and suggesting such hypotheses, sequences, and interrelations as are suggested on every page of this book will always be an important part of the scientific quest. In addition to these scientific values of this volume, there is, of course, its great practical and historical significance as a document, a portrayal of contemporary life, and an exposition of the latter's incongruities, their costs and their compensations in terms highly meaningful to the nontechnical reader. Such contents, assembled and presented with the competence here to be found, demonstrate again the outstanding talent of the authors in this field. Finally, the attention of statisticians may be called to the three statistical appendices on (1) population, (2) banking data in boom and depression, and (3) 51 miscellaneous tables on a great variety of economic and sociological topics. There is an excellent index.

GEORGE A. LUNDBERG

Bennington College

Can Delinquency be Measured? by Sophia Moses Robison. New York: Columbia University Press. Published for the Welfare Council of New York City. With a Foreword by Professor R. M. McIver. 1936. xxvi, 277 pp. $3.00.

One of the fundamental problems of the methodology of the social sciences is the definition of terms used. Sometimes these terms are designations of things described or counted; again they are units of measurement. In this painstakingly critical study, Mrs. Robison attacks a problem that has too long gone uninvestigated, namely, the unit of measurement in juvenile delinquency.

Practically all the studies of delinquency that have involved a measurement of its amount have relied on one definition of a delinquent or of a

delinquency, namely, that which implies official contact with a court handling juveniles brought in for being delinquent. The definition of delinquency in practically all the states is so broad that it includes not only the crimes with which adults might be charged but also many acts that are not in the criminal code. In this respect it differs sharply from the definitions of crimes, which are exceedingly explicit and very exactly construed by the courts. This vagueness of definition is, then, an underlying weakness in the use of the term "delinquency." The core of the present inquiry is not this vagueness, however, but it is the inadequacy of the official recognition by a court as a definition of a delinquent or a delinquency.

The inadequacy of court recognition has long been known and discussed in crime statistics. Although many European countries have based their indexes of crime upon the number of persons charged, or of cases begun in the courts, there is general agreement now that these are faulty measures of crime. Today we look to the reports of crimes known to the police for a more sensitive index than that of cases in the courts. We are well aware of the inadequacy of even these sources, for many crimes are not reported at all and some of those reported never occurred. We assume—for want of more certain information—that about the same proportion of all crimes will be known to the police from time to time and from place to place. The latter phase of the assumption is perhaps the weaker of the two. Both depend on a further premise of honesty and industry by the police in the reporting procedure. It has been pointed out that court statistics, because of their foundation on public records, have a superior validity as sources. In some respects this point may be true, but there are so many slips 'twixt the commission of the crime and its appearance on a court docket that this superiority is more apparent than real.

Like many other good pieces of critical work, this is an attack on a position of great respectability in the field. The ecological studies of Shaw and his co-workers in Chicago and other American cities have attracted much interest and approval. Briefly their position is this. Certain areas of American cities are in a state of deterioration. The forces of city growth produce this effect, through the crowding and proximity of the central business section, through the movement of the population outward in proportion to its income, and through the rapid physical decay of housing. Specifically, a deteriorated area is near the business and manufacturing centers, has speculatively high land values with no immediate commercial use for the land, the absentee owners of which allow the houses to run down. Such areas are inhabited by the poorest elements of the community, usually immigrants, some from Europe and others from the South of the United States. Successive immigrant groups pass through these areas on their way up the economic ladder. But the area remains, and its pernicious effects are felt in each of these waves of immigrants.

Shaw found that there was a definite falling off in delinquency rates as one progressed from the center to the periphery of Chicago. The evidence

seems not so strong for other cities, although some fundamental similarities were found there also. For Chicago this tendency is found to hold for truancy and adult crime as well.

Mrs. Robison points out the following characteristics of these (and several other) studies:

1. Only apprehended delinquents are counted.
2. There is insufficient subclassification of delinquents by age, sex, and types of delinquency.
3. No question is raised as to the "fundamental appropriateness of a geographical rate, though there is some consideration of the size of the geographical area."

She raises the following questions:

1. What is the real relationship between the amount of apprehended and unapprehended delinquency? Can this relationship be measured?
2. Are there constant factors which influence the official registration of delinquent behavior?

To answer these questions she conducted an analysis of these series of cases of the calendar year 1930:

Series A: 10,374 delinquents, of whom 7,090 were known to the Children's Court, 2,116 to official agencies other than Children's Court, 828 to unofficial agencies, and 340 to mental hygiene clinics. For all of these it was the first contact with the agency.

Series B: 3,132 carried over from a previous year, classified as in Series A by type of agency.

Series C: 3,668 truants, children known either to the Bureau of Attendance, or to other agencies, or to both.

The conclusions which the author reaches may be classified as follows:

The recognition of the behavior of children as delinquent will be determined to a considerable degree by group attitudes and customs. A more accurate description of the particular type of behavior is therefore necessary.

"Court figures in New York City neither measure the extent of juvenile delinquent behavior, nor do they represent necessarily the more serious types of anti-social conduct." Moreover, different areas show variations in reporting delinquent behavior, depending frequently on police activity, activity of unofficial agencies, and the abundance or lack of facilities for the care of children of a particular race or religious affiliation.

Differences appear with regard to sex and age. Fewer girls and fewer children under 10 appear in the court than in the unofficial agencies. Negro children appear almost exclusively in the Children's Court and other official agencies. New York City has roughly equal proportions of Catholics, Protestants, and Jews. In the court figures there are roughly seven Catholic children to one Protestant, and three Catholics to one Jew. In the total count the Catholic-Protestant ratio remains the same (seven to one) but the Catholic-Jewish ratio falls to two and one-half to one. Religious categories however, are not homogeneous, Irish (Catholic) children furnish less than

their proportion of delinquency and Italian (also Catholic) children furnish more when compared with their proportions in the child population. Again, children of immigrant parents show different proportions of delinquency: both Italians and Russian Jews have this handicap, but the Italians make a far worse adjustment.

As for the precipitating question of this study, the feasibility of area studies of delinquents, the author summarized her findings as follows:

The fraction which becomes a rate has as its numerator the number of delinquents and as its denominator the number of children "at risk," i.e., of the appropriate ages in the given area. If the definition of delinquency is that of official recognition, the numerator has different meanings as one passes from one area to another, from one race to another, from one cultural group to another. The denominator is directly related to the size of the area. If the area is too small, the rate is unreliable when subjected to the usual tests. If the area is large, then the rate ceases to have any significance because of the heterogeneity of the population base. Furthermore, recent studies of the methodology of geographical rates throw grave doubt on the applicability of the mathematical tests to the rate based on an area population.

Finally, the author finds no evidence in New York City of the concentric pattern of delinquency found by Shaw in Chicago. This difference has topographic and historical reasons. It throws doubt on the universality of at least certain of the Chicago author's generalizations.

The reviewer must add a note of approval for the skill with which the statistical analysis in this study has been carried out. It seems at every point to leave no hole in the armor of reasoning. The author lays no claim to having made any great contribution to the inquiry as to causes of delinquency. She has, however, put up a sign on this road of investigation: "Road under repair. Travel at your own risk!"

C. E. GEHLKE

Western Reserve University

Child Workers in America, by Katherine D. Lumpkin and Dorothy W. Douglas. New York: Robert M. McBride & Company. 1937. Appendix, 292 pp. $3.50.

Intensive investigation of several hundred family histories of child labor experience underlie the authors' approach to this study. The book, therefore, goes beyond the confines of the census statistics of child workers and studies them in their family and class surroundings. This is why the authors can and do so convincingly demonstrate that coupled with the economic exploitation of minors goes much of their deprivation of educational and physical development.

In the South, the relatively larger proportion of child workers come from Negro homes and from the homes of tenant families both Negro and White.

Everywhere, in the North and the South, they come from the homes of the poorest working class families. It is a characteristic of child labor throughout that the very exploitation of the child workers makes possible the exploitation of the parents and elder brothers and sisters. In times of mass unemployment, the adults in the family lose their jobs first. During the 3 years 1929–31, in the group studied by the authors, 60 per cent of the fathers suffered the experience of unemployment; 40 per cent of their sons and daughters 20 years of age and over; but only 25 per cent of the members of the families ages 16 to 20.

No special group of employers is guilty of the economic exploitation of children. Child labor is employed because it is cheaper, and any and all business will employ child labor if and whenever it can be successfully substituted for adult labor. "The matter boils down to this," the authors state, "when businesses consider the labor of children to be not only cheap, but sufficiently productive to be profitable, children are hired." "Primarily," they add in another connection, "children are forced onto the labor market by the condition of poverty and the threat of economic insecurity which is the common every-day experience of the American working class."

What to do about it? The history of regulation of child labor is a record of dismal failure. The opposition to reform has been too strong. Arrayed against the abolition or even effective regulation of child labor are all the business interests that profit by the labor of minor children. Supporting these business interests are a front of righteous dignitaries of church and culture.

President Nicholas Murray Butler opposed the Child Labor Amendment because, under it, Congress would "take over the control of the nation's children . . . " Said a Cardinal of the Catholic Church: "The Amendment now drawn is a long step in the direction of the nationalization of children which is the great desire of extreme socialists and bolshevists. . . "

New forces must, therefore, assume the struggle for the control and regulation of child labor, the authors contend. These must come from organized labor, having the support of the large middle class of small business men, farmers, and professional workers, and the struggle must be waged both on the economic and the political fronts. The authors do not delude themselves into thinking that child labor under the present system of business economics can be abolished. So long as business dictates the political and economic policies of the country, and so long as business profits from child labor, its complete abolition is unattainable, they maintain. Still, a great deal can be done by way of alleviating its most flagrant abuses. The authors propose three steps as requisite to such regulation and control:

1. Federal legislation applying to all occupations, industrial as well as agricultural, domestic as well as street trades. This requirement is self-evident in the face of the inadequacies and ineffectual enforcement of state legislation.

2. Universal compulsory education of adequate standards, Federally supported to insure enforcement.

3. A system of social insurance to protect wage-earning families against the loss of income occasioned by unemployment, sickness, accident, maternity, widowhood, and old age. The system of social insurance must be adequate "to create a bottom below which living standards are not allowed to fall, so that the wages of the children who usually try to find work are unnecessary. . . "

JOSEPH M. GILLMAN

Washington, D. C.

Twins: A Study of Heredity and Environment, by H. H. Newman, F. N. Freeman, and K. J. Holzinger. Chicago: The University of Chicago Press. 1937. xvi, 369 pp. $4.00.

For 10 years the authors have collected information on twins, and here they present the results of their investigation. This had for its main purpose "to secure evidence on the extent to which the characteristics of human beings, especially their ability and behaviour, are determined by their genetic constitution and the extent to which these characteristics are influenced by the conditions of the environment." Two series of cases constitute the material: a group of 100 pairs of twins reared together and a group of 19 pairs of identical twins who were brought up in different households.

The first series of cases was selected to include 50 pairs of identical and 50 pairs of fraternal twins, classified as such chiefly on the basis of similarity in palm and finger prints; physical appearance; color of hair, eyes, and skin; and in shape of teeth. The authors believe that this method of classification is more reliable than that based on the histologic study of chorions. It should be noted, however, that owing to the method employed there is no evidence that all the twins called identical are actually monozygotic. The differences between the two members of identical-twins pairs and of fraternal-twins pairs have been compared with respect to physical measurements: stature, weight, head length and breadth, and cephalic index, and to the results of psychological tests: Binet, Otis, Stanford Achievement, Downey, and Woodworth-Mathews. From the comparisons it appears that between twins classified as identical there is a high degree of resemblance in physique, much more than that found between twins of the fraternal group. These are, for certain dimensions, no more alike than ordinary sibs of the same sex. The degree of resemblance between twins classified as identical is not striking relative to their responses to tests of general ability, achievement, and personality or temperament; in a good number of cases identical twins appear to be as different as fraternal twins. It is inferred from these findings that mental traits, especially personality, are more influenced by environmental conditions than are physical traits. This conclusion may be entirely correct, but it cannot be accepted at face value

without corroboration because, it must be remembered, physical appearance was one of the principal criteria used in the classification of the twins.

The case histories of 19 pairs of identical twins who were reared in different households and who lived apart for a period of time varying from 13 to 34 years are presented in detail together with the results of physical measurements and psychological tests. It is found that in stature and head measurements, separated twins differ no more than identical twins reared together. In weight, intelligence, and school achievement, separated identical twins differ as much as fraternal twins. Moreover, there seems to be a high degree of correlation between differences in these characteristics and differences in environment.

The essential facts uncovered by the analysis of this mass of material appear to be that such characters as stature and head measurements are less susceptible, whereas weight and certain mental traits are more susceptible to environmental conditions. These facts are not sufficient to permit any broad generalizations, and the authors conclude that probably the main contribution of their investigation has been to indicate that the study of the relative influence of heredity and environment is far more complex than generally realized. It might be added that the complexities of the problem have been increased by the method of classification employed, as has been noted, and by the fact that psychological tests have at best a limited value as a measure of intelligence and other mental traits.

In a review limited to noting the essential findings, adequate justice cannot be done to this book, which represents one of the most complete and extensive works on the subject. The authors have critically reviewed the literature and discuss fully other aspects of this problem such, for example, as the probable significance of differences in handwriting. Of particular interest for the statistician are the methods employed in the analysis of differences between twins. Correlation and variance techniques have been utilized, and the comparisons of the results are instructive.

ANTONIO CIOCCO

The Johns Hopkins University

Principles of Medical Statistics, by A. Bradford Hill. London: The Lancet Ltd. 1937. vii, 171 pp. 6/–.

Followers of medical journals have noted the growth in the proportion of articles which are quantitative in character and have seen the need of medical workers for training in methods for handling such data. The editor of *The Lancet*, recognizing this need, last year invited Dr. A Bradford Hill, Reader in Epidemiology and Vital Statistics in the University of London, to prepare a series of simple articles on the statistical methods most useful in the medical field. These articles proved to be so valuable that *The Lancet* has now reissued them in book form.

The task which Dr. Hill undertook is not an easy one, for he attempts not only to set forth certain procedures with sufficient clarity so that the

nonmathematical reader will be equipped to apply them but also to show why they are needed and the philosophy underlying their development. It is gratifying to report that he succeeds admirably in this attempt. His success is largely due to the fact that he employs a wealth of medical illustrations and gives his explanations in terms of these examples rather than in mathematical language. The real strength of the book comes, however, from the interpretative discussion of results and emphasis on the logical principles basic in the reasoning.

The procedures selected for presentation have wisely been limited to a small number, yet they are sufficient for the great majority of problems encountered by the medical man. They include the tabulation of raw data into a frequency distribution; the calculation of mean, standard deviation, and correlation coefficient; sampling tests concerned with these constants, with percentages, and with frequency distributions; and analysis of survival after treatment in terms of life table procedure.

The discussion of these topics is enriched throughout by comments on aims, pitfalls, and interpretation in statistical treatment, but these considerations are not limited to the explanation of specific methods. They are further amplified in the first two chapters on aim of the statistical method, and selection, and in the last four chapters on fallacies and difficulties, and general summary. In these chapters, as in the intervening chapters on method, the medical man is treated, not to abstractions, but to a discussion of the concrete problems which he meets in quantitative studies.

There are three pages of definitions of terms and an adequate index at the end of the book.

One exception to the characteristic clarity of presentation occurs in the discussion of significance of difference of two percentages, where two alternative lines of reasoning are suggested (p. 74). The second alternative is confused in statement so that the question as to exactly what hypothesis is being tested is quite obscure. This alternative is mentioned but not clearly restated in the treatment of the difference between means.

For any person proposing to do work in quantitative biology and untrained in statistical methods, this book will furnish an excellent introduction to the reasoning involved in drawing sound conclusions, and it is a book that every medical man should absorb who is either a contributor to or a critical reader of the present-day medical journals.

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Physicians and Medical Care by Esther Lucile Brown. New York: Russell Sage Foundation. 1937. 202 pp. 75 cents.

It is a pleasure to greet the appearance of a layman's book on medical education and medical economics which can be recommended widely. Much is being published which pretends to be objective and authentic but which

is, in reality, merely the outpouring from propaganda groups. The non-expert in the field must be cautious and wary. Miss Brown is to be congratulated; she has run the gamut of the origins and evolution of medicine in the United States soundly and has managed to combine this with a discussion of current problems which is forthright and courageous as well as accurate and restrained. The continuity of the past with the present and with the future is subtly effected through the simple device of presenting 202 pages of text without breakdown into chapters. The sweep of the discussion is broad, and the pace is rapid. Diligence and skill have combined to produce a product which is wheat without chaff.

The origins of American medicine are very humble. It is apparent from this small volume that the problem of the nineteenth century was to devise means whereby physicians might be more adequately trained and the medical sciences developed to the point where they would provide a sound foundation on which the practice of medicine could be built. The degree of success with which this dual problem has been solved is little short of phenomenal.

Medicine is only an aspect of the general civilization of a country. This point is well illustrated for the nineteenth century in the United States by a passage, quoted by Miss Brown from President Charles W. Eliot. The young President of Harvard University was proposing moves in the interest of raising the standards of the Harvard Medical School. The head of the School was so greatly disturbed by the recommended changes that he declared the President was about to wreck it and that it would cease to exist in a year or two if such revolutionary reconstruction were allowed. "He actually proposed," said this professor, "to have written examinations for the degree of Doctor of Medicine. I had to tell him that he knew nothing about the quality of Harvard medical students. More than half of them can barely write. Of course they can't pass written examinations."

Contrast the situation which this quotation reveals with what is now required in medical training. One may feel justly proud of the heights through which medicine, assisted by the onward sweep of social evolution, has lifted itself by its bootstraps. It may not yet be said that all or even many of the fundamental problems in medical education and training have been "solved." "Solution" is dynamic and not static. Certainly, whoever may incline to be overly enthusiastic will have his spirit dampened when he considers the problems of specialization and its control with which medicine still finds itself confronted. Yet the past casts a shadow before, and a backward look gives encouragement. The march of events, their trends, their courses are well staked out in this little volume.

Changes in the number of medical students and graduates and changes in the number of physicians engaged in medical practice are here clearly shown to be related not only to trends in educational standards but also to the strivings for professional status. The distribution of physicians is related not only to these figures but also to the basic economic requirement

that even a physician must earn a living. Where there is poverty or limited purchasing power, there the medical equipment of society (hospitals and other facilities, as well as physicians) is often deficient; where there is wealth and purchasing power for medical service, as well as for other services or for material things, there is often an excessive equipment for medical care. Where the need for service is greatest, its deficiencies are also commonly greatest. These anomalies need correction, but the adjustments must be made carefully and skillfully, with due regard for the relations of excess or deficiency to *true need* as distinguished from current *effective demand.*

New forms of medical service fall into two broad classes: those concerned with new methods of furnishing service; those concerned with new arrangements to pay for it. Despite the long history behind many of these so-called new schemes, and despite their wide variety and the multiplicity of their accomplishments, they deal with only a fraction of the social need. But they are the experiments, and their successes and their failures will help to mark the paths along which larger undertakings will go. Miss Brown presents them for the reader in brief compass and with measured weight.

In her last section, under the title "Adequate Medical Care for All the People," Miss Brown has wisely discussed the history and *status quo* of health insurance and of state medicine. She does not, however, fall into the error—now widespread and common—of presenting these as mutually exclusive alternatives. To the contrary, her discussion makes as clear as may be, what is seen by all who are not blind to realities, namely, that health insurance and state medicine are mutually complementary and not mutually exclusive alternatives.

The following passages from the concluding pages deserve direct quotation:

> If the problem of the nineteenth century was that of the initiation of better medical schools and of concentration upon the basic sciences, the problem of the twentieth century is that of devising ways and means whereby adequate care can be provided for the entire population and physicians compensated fairly for the service rendered. This is primarily an economic problem, in which both physicians and society are involved, for both have much at stake. It matters little how excellent professional preparation may be, if the physician finds himself unable to render adequate care because of the persistence of outworn methods of delivering service or because of the inability of patients to pay for needed attention. From the point of view of society, it makes slight difference how many physicians there may be, if large parts of the population have not been taught to consult them and if plans have not been put into operation whereby the cost for those persons in the low-income groups can be so financed that they may have sufficient medical care.
>
> Various experiments, such as those in the field of voluntary health insurance that have already been recorded, look toward a partial solution of a pressing need. Studies of compulsory health insurance and extension of state-supported medical services point to other ways of making care more widely available. It is evident that thinking has shifted in the direction of the needs of the masses, and the demands of society become increasingly more exigent.

> Regardless of the attitude of those physicians and medical societies who would preserve the status quo, there are a great many individual physicians, members of the health services, and lay persons concerned with questions of health who believe that change is imminent, and that only through change can there be progress.

On the last point, there is ample verification in the documented study, *American Medicine: Expert Testimony Out of Court*, published by the American Foundation since the appearance of Miss Brown's book.

Finally, one word more. Though the casual reader may not recognize it, this little book required delicacy in preparation and courage in publication. In addition, however, it required courage from the sponsor. The subjects are controversial, and missteps are costly. All who will read it will feel an obligation and a debt to The Russell Sage Foundation under whose auspices it was prepared and published.

I. S. FALK

Washington, D. C.

Cost of Government in the United States 1934–1936, by Lewis H. Kimmel. New York: National Industrial Conference Board, Inc. N.I.C.B. Studies Number 235. May 1937. xiii, 137 pp. $3.50.

This is the twelfth volume of the National Industrial Conference Board's series presenting data of the cost of government in the United States. For state and local governments the only comprehensive figures are those compiled by the United States Bureau of the Census once in every 10 years. The task of the National Industrial Conference Board, therefore, has been first to collect such data as are available and, by means of carefully compiled estimates, some of them based upon data obtained by questionnaires and other correspondence, to supply annual totals. Secondly, it has been to bring together these figures of state and local units and the data for the Federal Government. The task obviously involves much labor, and the National Industrial Conference Board is to be commended for making this convenient summary available currently to the public. The material is presented in 52 tables and 9 charts with appropriate textual comments, the present volume running to 137 pages in all—an extremely compact presentation for such a body of facts.

In view of the problem of Federal finances, particular attention is given to this subject in the present volume, the discussion going somewhat beyond the textual summary of the data to which most of the comment in the book is confined. In addition to the discussion of Federal finance in conjunction with expenditures and taxation of the other governmental units, a separate brief chapter is devoted to the Federal deficit. Expenditures, receipts, and the resulting deficit are presented through the fiscal year 1936, and these figures are followed by a brief discussion of the budgets for the two following fiscal years. The very large deficit for 1936, amounting

to 4-¾ billion dollars, was attributable, to the extent of 1-¾ billion dollars, to payments under the Adjusted Compensation Payment Act. Aside from this item, the highest deficit appeared in 1934 (3.6 billion dollars); the 1935 deficit amounted to 2.9 billions. In commenting upon the budgets for 1937 and 1938, the author points out that the estimates of future expenditures depend upon assumptions which may or may not be fulfilled. In connection with the resulting growth in the Federal debt the text brings forward briefly the main problems involved: the persistence of the upward trend; the extent to which Federal obligations have found their way into the banking system; the necessity of recurrent refunding operations of considerable size; and the question of the absorption of the debt into the social security funds if the reserve system established for these funds is carried out as now provided in the law.

The figures compiled by the Board for local indebtedness make possible comparison with Federal indebtedness. In 1922, when Federal indebtedness stood at 23 billion dollars, the state and local figures totaled 10 billion dollars. Up to 1930 the expansion of the latter indebtedness more than offset the reduction effected by the Federal Government, so that the total stood at 34 billion dollars, with a slightly higher figure for states and localities than for the United States (18 billion dollars against 16 billion dollars). From 1934 through 1936, while Federal indebtedness was increasing to over 33-½ billion dollars, state and local indebtedness likewise rose, reaching about 20 billion dollars; the total for the two was thus about 53-½ billion dollars.

Comparison of the amounts of indebtedness in this country is made with the debts of Great Britain, Germany, and France, with due warning that the figures are not to be considered strictly comparable. In sharp contrast with the expansion in the United States debt from 1930–1936, which amounted to 56 per cent, the British debt rose only 6 per cent but was still considerably heavier per capita, amounting to approximately $1,000 a person, on the basis of $5 pounds, as against $416 in the United States. Indebtedness in Germany and France has shown smaller increases than in the United States. The figures indicate that the known debt was much smaller in Germany than in the United States, whereas the French debt was "closer to that of the United States than are the debts of the United Kingdom and Germany."

Second in the public interest only to the foregoing general considerations is the question of the extent to which the Federal Government has taken upon itself the relief burden during the years of depression and recovery. Figures taken from the Federal Emergency Relief Administration show totals rising from 793 million dollars in 1933 to 1,827 million dollars in 1935. Of these sums the Federal Government supplied 61 per cent in 1933, 72 per cent in 1934, and 74 per cent in 1935. The extent to which the Federal Government has become the agency of relief is indicated even more clearly by the fact that in three sections of the country—the South Atlantic states,

the East South Central states, and the West South Central states—it furnished over 90 per cent of the total in 1935. Only in the New England states was the percentage less than 60; only this section and the Middle Atlantic states show percentages below the average for the country (74 per cent).

The more general comparisons between Federal and state and local operations are also of interest and importance. The figures show that the decade of the twenties when Federal expenditures were increased little, was, nevertheless, a period of large expansion because of the rise in the amount spent by the state and local governments. The annual total increased from 9 billion dollars in 1923 to 12 billion dollars in 1930. By 1935 (the last year for which comprehensive expenditure figures are given) the aggregate had risen to 15 billion dollars as the result of increased Federal expenditure. The latter, which had formed 35 per cent of the total in 1923 and dropped to 27 per cent in 1930, formed 46 per cent of the total in 1935. The general record of tax collections is not greatly unlike that of expenditures. Comparing the years 1930 and 1935 we find Federal tax collections exceeding the 1930 figure by about 80 million dollars and state tax collections by 95 million dollars, whereas local taxes were 722 million dollars lower. The total for 1935, 9.7 billion dollars, was approximately 550 million dollars less than in 1930. Nontax receipts were estimated at 2 billion dollars for all governments in 1935.

Some judgment of the weight of the tax burden is possible by a comparison of the Conference Board's figures with national income. Tax collections in 1923 amounted to 11 per cent of such income and those in 1930 to 14.2 per cent. By 1935 the percentage had increased to 17.7, the last figured against the national income of 55 billion dollars. Whether national income has kept step with the increase in taxation since that year remains to be seen. Another method of judging weight of taxes in the United States is through comparison with those in the United Kingdom, France, and Germany. There is obviously difficulty in making direct comparisons on a per capita or income basis. The National Industrial Conference Board has presented the material in the form of a chart showing tax collections in these three countries since 1930. This shows graphically the fact that British taxes have been maintained throughout the depression, in 1935 standing 6 per cent above 1930. The United States, France, and Germany show sharp declines in the intervening years, but it is noteworthy that the 1935 tax collections in the United States were within 5 per cent of the 1930 figure and in Germany within 7 per cent of that figure.

The contribution of the National Industrial Conference Board volume consists in supplying data upon which some appraisal of the cost of our government activities is possible, and in bringing together information upon all government bodies so that the water-tight compartments into which thought on governmental finance tends to fall are broken down. Most statistical critics will probably find the explanation of methods given in

the appendix unsatisfactory for their purposes; it was, perhaps, not designed to meet such needs. The chief difficulty lies in the fact that the information given does not make possible a mathematical statement regarding the importance of the estimated portion of the figures. Presumably this portion is greater in the most recent years reported than in the earlier years, and, also presumably, it is not sufficiently important to impair the validity of the most recent figures, but there is little in the present description of methods which would enable the reader to form a mathematical judgment on these points.

JOSEPH B. HUBBARD

Harvard Business School

Facing the Tax Problem, A survey of Taxation in the United States and a Program for the Future. New York: Prepared under the Auspices of the Committee on Taxation of the Twentieth Century Fund, Inc. 1937. xxiii, 606 pp. $3.00.

This volume was prepared under the auspices of a Committee on Taxation of the Twentieth Century Fund. The research work was carried on under the direction of Professor Carl Shoup (Columbia), research director, and two associate directors, Professor Roy Blough (Cincinnati) and Professor Mabel Newcomer (Vassar), who were assisted by a staff of 17 members.

The book aims to describe the taxation system now existing in the United States including state and local taxes as well as Federal taxes. It goes further and not only presents a valuable critique of these various taxes individually and as a whole (summing this up in 102 conclusions) but makes specific recommendations as to what should be done to improve them. There are two sets of recommendations: first, the directors of the survey present 50; and, then, the Committee on Taxation of the Twentieth Century Fund make some 35 recommendations covering a much more limited area than that covered by the directors. A considerable number of the recommendations of the Committee coincide with those made by the directors, but the Committee adds some of its own and in its report presents some interesting material not found in the survey.

There are some places in the study in which statements are made without enough of the material upon which they were based being presented. In most of these cases, however, reference is made to another volume, "Studies in Current Tax Problems," which is to be a companion study of the one under consideration and which will undoubtedly supply this material.

The weakest portion of this study, in the judgment of the reviewer, is the chapter dealing with the distribution of the tax burden. The writer of this chapter recognizes the difficulties of this problem and qualifies the results. The reviewer in no way wishes to criticize the work of this writer but merely expresses his opinion that so many assumptions must of necessity be made

in working on this problem that any conclusions reached cannot be relied upon to any great degree.

The study is most excellently organized and unusually well annotated, as might be implied from the fact that there are 72 pages of notes. There is also a good bibliography. The volume is one of the most comprehensive works on taxation that has appeared and should be owned by every student of public finance and studied carefully by all who are interested in trying to make use of taxes as a means of social control or for any reason to change in any respect our present system of taxation.

HENRY F. WALRADT

Ohio State University

How Shall Business Be Taxed? New York: Symposium conducted by the Tax Policy League, December 28–29, 1936, in Chicago, Illinois. 1937. vii, 175 pp. $2.50.

This volume contains 12 papers presented in a conference conducted under the auspices of the Tax Policy League on the problem of business taxation. The treatment is limited in its scope, as there is no discussion either of the special taxes placed upon particular kinds of business or of the various forms of property, sales, and franchise taxes which affect business enterprise. Considerable space is devoted to theory underlying business taxation, and special attention is given to the discussion of the very timely subjects of the financing of social security and the taxation of undistributed profits. One of the best papers, in the opinion of the reviewer, discusses the question as to whether flat or graduated rates should be used in connection with business net income taxes, and the conclusion reached is in favor of a flat rate. A very good, although not complete, bibliography of business taxation adds to the value of this very readable volume.

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